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Trace-Element Sensitivity: Comparison of Activation Analysis with Other Methods: <i>W. W. Meinke</i>	177
The Scientist as a Citizen: <i>J. B. Schenken</i>	184
Theodore Lyman, a Pioneer in Far Ultraviolet Spectroscopy: <i>F. A. Saunders</i>	187

News and Notes

A Return to Reason; Problems of Comparative Behavior; and Regular Departments	188
--	-----

Book Reviews

<i>Optical Image Evaluation; Plant Regulators in Agriculture; Thermo- Mikro-Methoden; Amphibians and Reptiles of Western North America; Biochemical Determinants of Microbial Diseases; Differential Equations with Applications; Psychomotor Aspects of Mental Disease; Elementary Chemical Composition of Marine Organisms; Qualitative Inorganic Analy- sis; Introduction to Human Biochemical Genetics; General Theory of High Speed Aerodynamics; New Books; and Miscellaneous Publications</i>	200
--	-----

Technical Papers

Nomenclature and Structure of 1,2,3,4,5,6-Hexachlorocyclohexanes: <i>I. Hornstein</i>	206
Partial Charges on Atoms in Organic Compounds: <i>R. T. Sanderson</i>	207
New Blocking Agent against the Development of LSD-25 Psychosis: <i>H. D. Fabing</i>	208
Role of Cytochrome and Pyridine Nucleotide in Algal Photosynthesis: <i>L. N. M. Duysens</i>	210
Carbon Dioxide Fixation by Roots: <i>G. E. Graf and S. Aronoff</i>	211
Rapid Method for Determining Mean Values and Areas Graphically: <i>S. I. Askovitz</i>	212
Inhibition of Root Growth by Azaserine: <i>A. G. Norman</i>	213

Communications

Wastes and Nutrients: <i>O. S. Gibbs; P. B. Sears</i>	214
C ¹⁴ -Labeled Ergot Alkaloids: <i>A. G. Paul and A. E. Schwarting</i>	215
Diffusion Constant and Diffusion Coefficient: <i>J. Verduin</i>	215
Antibiotic Effect on <i>Ceratostomella fimbriata</i> of Ipomeamarone, an Abnormal Metabolite in Black Rot of Sweetpotato: <i>I. Uritani and T. Akazawa</i>	216
Chemopallidectomy: An Investigative Technique in Geriatric Parkinsonisms: <i>I. S. Cooper</i>	217

Association Affairs

International Arid Lands Meetings in New Mexico: <i>G. F. White</i> and <i>P. C. Duisberg</i>	218
Advice on Loyalty Requirements	7A
Meetings & Conferences	12A

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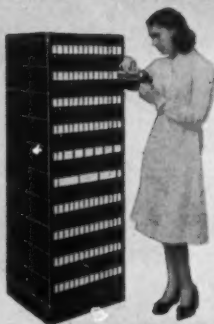


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Trace-Element Sensitivity: Comparison of Activation Analysis with Other Methods

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ACTIVATION analysis is a method for determining the constituents of a sample by utilizing certain nuclear properties of the isotopes of the elements in the sample. Nuclear particles are used to produce radioactive isotopes by activation of the nuclei of the sample elements. These radioisotopes can be detected and measured by their nuclear radiations. Thus with an exact knowledge of nuclear characteristics, a determination of the amount of element present can be made. This method is applicable to determination of trace elements in many types of materials used by the biologist, chemist, metallurgist, physicist, and others. Solid, as well as liquid, samples can be used for the analysis; a few milligrams or less of material is sufficient for precise work. When chemical separations are required in activation analysis to remove interfering ions, no errors are introduced by trace contaminants in the reagents.

Analysis by radioactivation was first suggested by Hevesy and Levi (1) in 1936 when they used neutrons from a 300-mc radium-emanation beryllium source to activate certain rare-earth elements. It was not until the advent of the nuclear reactor, however, that sources of sufficiently high neutron flux became available to give high sensitivity to this method.

In the past decade activation analysis has been viewed by many as representing the ultimate in sensitivity. The completion of new reactors with increasingly high fluxes brought a steady improvement in this sensitivity. Most analysts, however, had to forego the reportedly high sensitivities and had to use the more conventional methods of analysis because there were few reactor facilities available and access to them was limited.

In 1952 Oak Ridge National Laboratory made available to the public an activation analysis service (2, 3) that has since enjoyed a favorable response. At the present time several non-AEC laboratories are building research-type reactors (4) and the prospects for many more reactor facilities being built in the near future are good.

This increase in access and availability of sources of high neutron flux will proportionately increase the ease of obtaining analysis by activation. Not only will it be possible to send samples out to any of several laboratories for this type of analysis, but in areas

near a reactor an investigator should be able to make his own analysis at the reactor facility.

Thus some critical evaluation of activation analysis as a method for determining trace quantities of elements is necessary to ascertain its advantages and limitations relative to other existing methods of trace analysis. Limits of sensitivity for various methods can be found in the literature. Although these limits vary with investigators, types of equipment, experimental procedure, and so forth, rough comparisons of these limits for each element can provide invaluable insight into the value of activation analysis relative to other methods of trace analysis.

Activation analysis. A number of general papers (5-15) on activation analysis should be consulted for background information on the method. The general equation governing analysis by activation is

$$\text{Grams of } X = \frac{\text{Act.} \times \text{at.wt.}}{6.02 \times 10^{23} f (\sigma_{at}) \left(1 - e^{-\frac{-0.693t}{t_{1/2}}} \right)}$$

where Act. is the activity (disintegrations/min); at.wt. is the atomic weight of isotope activated; f is the flux of neutrons (neutrons/cm² sec); (σ_{at}) is the atomic cross section of element—that is the isotopic cross section \times percentage abundance of isotope (the cross section is a measure of the probability of activation for a particular isotope; a compilation of isotopic cross sections can be found in the literature);

and $\left(1 - e^{-\frac{-0.693t}{t_{1/2}}} \right)$ is the saturation factor which depends upon the ratio between length of bombardment and the length of half-life of the isotope formed; t is the time of bombardment; and $t_{1/2}$ is the half-life of isotope produced.

From this equation it can be seen that the activity for a given number of grams of material is directly proportional to the neutron flux. Furthermore, the number of grams of a material that gives a specified activity is inversely proportional to the flux. Thus the higher the neutron flux, the higher the sensitivity for detection of a given isotope.

Table 1 is a list of the average thermal neutron flux available from different sources of neutrons. A corollary to the fact that higher neutron fluxes give higher

Table 1. Neutron sources and usable flux (in n/cm² sec).

Ra-Be, 25 mg		10 ⁸ - 10 ⁹
Sb-Be, 1 c		10 ⁸ - 10 ⁹
Van de Graaf		10 ⁷ - 5 × 10 ⁸
Cyclotron		10 ⁶ - 10 ⁸
Reactor		
Oak Ridge	X-10	5 × 10 ¹³
Oak Ridge	LITR	1 × 10 ¹³
Brookhaven	BNL	2 × 10 ¹³
Chalk River	NRX	2 × 10 ¹³
Idaho	MTR	2 × 10 ¹⁴

sensitivities is the fact that lower level neutron sources can be used whenever lower sensitivities can be tolerated for an analysis. Hence even the portable low-level radium-beryllium and antimony-beryllium sources can be used for analysis on occasion (10, 16).

Order of magnitude sensitivities of various elements for activation analysis in the 5 × 10¹³ neutrons/cm² sec flux of the Oak Ridge X-10 reactor have been published (2). The sensitivities are shown in Figs. 1-4 (17). One additional chart could be made showing only europium and dysprosium with a sensitivity of 10⁻⁵ µg or less for the X-10 reactor. Values for higher flux reactors are also listed on the charts.

Comparisons. Table 2 is a comparison of the sensitivities for the elements reported for activation analysis by Leddicotte and Reynolds (9) with those for five other typical trace analysis methods for solutions and soluble salts. These methods do not necessarily represent the five best methods for trace analysis but were chosen as typical methods in general use.

It was necessary to make a number of assumptions in order to make the comparison. Lists of sensitivity limits as published by an authority in the field were taken without any further individual evaluation. Higher sensitivities for one element or group of elements may now be possible because of recent perfection of new procedures. In addition sensitivities for an entire method might be increased by suitable improvements in technique. Neither of these possibilities has been taken into consideration in making these comparisons. Gross normalizing factors were introduced for each method to adjust the values to the same units as the activation analysis values.

The problem of interfering ions and the necessity, in some cases, for chemical separations before the indicated sensitivity can be obtained are completely neglected even though they play a very important practical role in the problem. The speed with which the analyses are made is not considered. Finally the problem of multiple-element analysis in a single sample is not considered.

Regardless of these limitations, the comparison is worth while in that it readily points out the few elements for which activation analysis is particularly well suited and also the few for which it is not. It also shows elements for which activation gives only relatively fair sensitivity but for which it is very useful because other methods are at present much less sensitive.

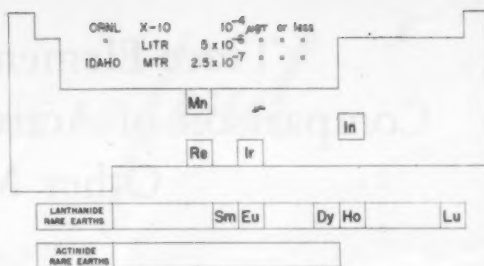


Fig. 1. Elements with thermal neutron activation sensitivity of 10⁻⁴ µg or less in the Oak Ridge X-10 reactor.

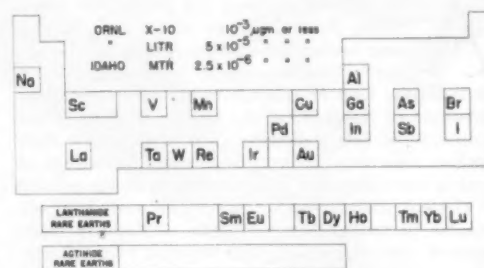


Fig. 2. Elements with thermal neutron activation sensitivity of 10⁻³ µg or less in the Oak Ridge X-10 reactor.

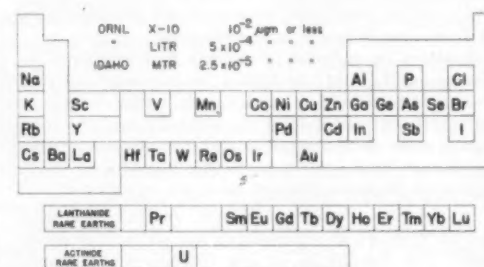


Fig. 3. Elements with thermal neutron activation sensitivity of 10⁻² µg or less in the Oak Ridge X-10 reactor.

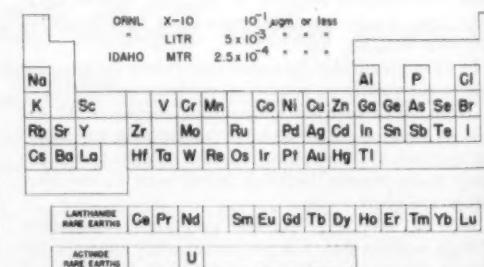


Fig. 4. Elements with thermal neutron activation sensitivity of 10⁻¹ µg or less in the Oak Ridge X-10 reactor.

Table 2. Sensitivity comparisons ($\mu\text{g/ml}$).

Z	Element	Methods						
		Oak Ridge X-10 reactor	Oak Ridge LITR reactor	Copper spark	Graphite direct- current arc	Flame spectro- photometer	Sensitive color reaction	Ampero- metric titration
1	H							
2	He					0.02		
3	Li			0.002		250.	0.04	
4	Be			.002		10.		
5	B			.1				
6	C							
7	N							
8	O							0.25
9	F			.1				
10	Ne					0.002		
11	Na	0.007	0.00035	.1	20.	1.	.06	
12	Mg	.6	.03	.01	0.1	20.	.002	300.
13	Al	.001	.00005	.1	.2		.1	
14	Si	1.	.05	.1	2.		.01	15.
15	P	0.02	.001	20.	50.			5.
16	S	4.	.2				.04	10.
17	Cl	0.03	.0015					
18	A			0.1		0.01		100.
19	K	.08	.004	.1		.03		100.
20	Ca	3.8	.19	.005				
21	Sc	0.002	.0001	.1		2.	.03	~ 10.
22	Ti			.05		2.	.2	3.
23	V	.001	.00005	.05		1.	.02	1.
24	Cr	.2	.01	.05	2.	0.1	.001	0.0003
25	Mn	.0006	.00003	.02	0.2	2.	.05	2.
26	Fe	9.	.45	.5	.2	10.	.025	100.
27	Co	0.02	.001	.5		10.	.04	0.5
28	Ni	.03	.0015	.1	4.	0.1	.03	10.
29	Cu	.007	.00035		0.2	2000.	.016	10.
30	Zn	.04	.002	2.	20.	1.		
31	Ga	.007	.00035	1.			.08	
32	Ge	.04	.002				.1	0.4
33	As	.002	.0001	5.	10.			
34	Se	.05	.0025					200.
35	Br	.003	.00015					
36	Kr					0.1		
37	Rb	.03	.0015	0.2		.1		
38	Sr	.6	.03	.5		50.		
39	Y	.01	.0005	.01			.13	
40	Zr	.3	.015	.1		20.	50.	
41	Nb	10.	.5	.2		30.	0.1	5.
42	Mo	0.1	.005	.05				
43	Te					10.	.2	
44	Ru	.1	.005			1.	.2	
45	Rh					1.	.1	
46	Pd	.005	.00025	.5		0.5	.1	1.
47	Ag	.11	.0055		0.1	20.	.01	5.
48	Cd	.05	.0025	2.	4.	1.	.2	100.
49	In	.0001	.000005	1.		10.		2.
50	Sn	.2	.01		0.2		.03	10.
51	Sb	.004	.0002	5.	4.	100.	.5	
52	Te	.1	.005	0.5				1.
53	I	.002	.0001					
54	Xe					1.		
55	Cs	.03	.0015	.5		3.		25.
56	Ba	.05	.0025	.1		5.		
57	La	.002	.0001	.05		20.	.25	~ 500.
58	Ce	.1	.005	.5		100.		
59	Pr	.002	.0001	.2				

Z	Element	Methods						
		Oak Ridge X-10 reactor	Oak Ridge LITR reactor	Copper spark	Graphite direct- current arc	Flame spectro- photometer	Sensitive color reaction	Ampero- metric titration
60	Nd	.1	.005	.2		50.		
61	Pm							
62	Sm	.0006	.00003	.2		100.		
63	Eu	.00003	.0000015	.02				
64	Gd	.02	.001	.1		10.		
65	Tb	.004	.0002					
66	Dy	.00003	.0000015	.5		10.		
67	Ho	.0004	.00002	.2				
68	Er	.02	.001	.5				
69	Tm	.002	.0001	.05				
70	Yb	.002	.0001	.1				
71	Lu	.0003	.000015	2.				
72	Hf	.02	.001	0.5				
73	Ta	.007	.00035	1.				
74	W	.003	.00015	0.5			0.4	
75	Re	.0006	.00003	2.			.05	
76	Os	.02	.001				1.	
77	Ir	.0003	.000015	5.			2.	
78	Pt	.1	.005	0.02			0.2	
79	Au	.003	.00015	.2		200.	.1	
80	Hg	.13	.0065	5.	2.*	100.	.08	
81	Tl	.6	.03		0.2	1.		
82	Pb	2.	.1	0.05	.2	20.	.03	3.
83	Bi	~ 0.4	~ .02	.2	.2	300.	1.	300.
84	Po							
85	At							
86	Em							
87	Fr							
88	Ra			.1				
89	Ac							
90	Th			.2				
91	Pa			2.				
92	U	.01	.0005	1.		10.	0.7	

In Table 2, sensitivities that can be obtained by activation analysis with two different nuclear reactors are compared with sensitivities for the other methods. Sensitivities for each element and method are those reported in the compilations of data listed here. Certain gross normalizing factors, however, were used for each method to adjust the values to the common sensitivity basis of "micrograms per milliliter" and an error of about 10 percent. It was assumed that as much as 25 or 50 ml of the unknown solution was available.

The values listed in the table represent an *order of magnitude only*, since peculiarities of experimental procedure, investigators, and so forth, introduce considerable variation. For activation analysis they represent conservative values, although values for other methods may be somewhat optimistic. Several of the methods are capable of an increase in sensitivity of a factor of 10 or more by a change of equipment or the use of larger samples, and so forth, if they were to be pushed to the limit.

The table, although not complete, is presented as a basis for general comparisons of the methods or as a type of work sheet. Pertinent information on each method follows.

Oak Ridge X-10 reactor. Values are listed by Leddicotte and Reynolds (9) for activation analysis in the Oak Ridge X-10 reactor at a flux of 5×10^{13} neutrons/cm² sec to give 40 disintegrations/sec. Samples are activated to saturation or 30 days, whichever is shorter. It is assumed that a 1-ml sample is evaporated per analysis. The sensitivity of the method could be substantially increased by increasing the volume of sample used. The primary limitation is the effect of self-absorption of the bulky sample upon the radiations emitted by the radioisotope. If it were desired to increase the sensitivity further, samples with activity less than 40 disintegrations/sec might be accepted. With special techniques an activated isotope having about one-tenth of this activity could be determined.

Oak Ridge LITR reactor. Values are given for activation analysis in the Oak Ridge LITR reactor (or proposed university research reactors at full power) at a flux of 10^{13} neutrons/cm² sec. All other conditions and comments are identical to those given for the X-10 reactor.

Copper spark. The original sensitivity values from which these were derived are listed by Nachtrieb (18) for spectrographic analysis using the copper-spark method. It is assumed that for best results only 1/20 ml of sample can be evaporated on the electrode. If more sample could be evaporated without interfering seriously with the analysis, the sensitivity relative to activation would increase. Nachtrieb gives his data in millimicrograms using a 50-lambda sample and estimating an error of ± 3 to 8 percent. His values were divided by 1000 to convert to micrograms, multiplied by 20 to adjust to the basis of a 1-ml sample, and divided by 2 to allow for an error of ± 10 percent. The net result was to divide the literature values by 100 for the comparison.

Graphite direct-current arc. The original values are also listed by Nachtrieb (18) for spectrographic analysis using graphite direct-current arc methods. It is assumed that 1/20 ml of sample was evaporated on the electrode. All comments on normalization given for the copper-spark method apply to this method. The literature values were divided by 100 to obtain the comparison value.

Flame spectrophotometer. The original sensitivity values for analysis using the flame spectrophotometer with an oxyhydrogen flame are given in Beckman Reprint R-56 (19). Values were given directly in micrograms per milliliter. The errors given for the reported sensitivities were ± 100 percent. The values were therefore multiplied by a normalizing factor of 10 to convert them to the same ± 10 percent error as the other methods.

Sensitive color reaction. The original sensitivity values for spectrophotometric analysis using sensitive color reactions were taken from Sandell (20). The values are given in micrograms per square centimeter. It was assumed that a standard 1-cm cell was used in the spectrophotometer, although the 10-cm cells available could increase the sensitivity by a factor of 10. As in the case of flame photometry, the original values were given with a ± 100 -percent error and were multiplied by a normalizing factor of 10 to convert to the prescribed basis.

Amperometric titration. The original values for amperometric titration are listed in a compilation made by Sargent and Co. (21). These values were not all converted to the same units in the compilation; some were given as micrograms, others as molarity, and so forth, with different limits of error. For this comparison, the sensitivity

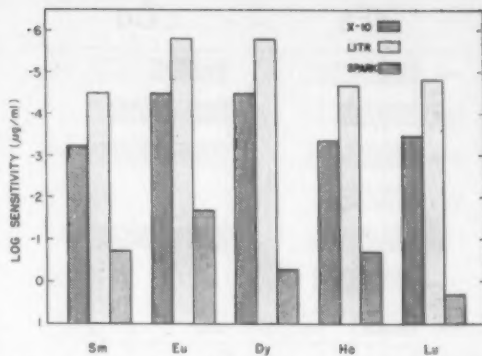


Fig. 5. Comparison graphs of some rare earth elements having high sensitivity for activation analysis.

values were converted as nearly as possible to the common basis of the other methods considered. The normalized values, however, are much less certain than values presented for the other methods. Recent work on coulometric analysis may have superseded some of the lower sensitivity values for a number of the elements.

Comparison graphs. Comparisons of these methods can be seen much more readily when they are presented in graphic form. Therefore methods for certain elements of importance have been compared graphically.

Certain of the rare-earth elements show the highest sensitivity of any elements for activation analysis. These are shown in Fig. 5 compared with the values for spark spectroscopy. For europium and dysprosium truly fantastic sensitivities can be obtained. For each of the elements shown in this figure, analysis by activation so far overshadows other methods that it is possible to obtain sensitive analysis with neutron fluxes much lower than those of a reactor.

Manganese, indium, rhenium, and iridium are four other elements that show high sensitivity on the chart

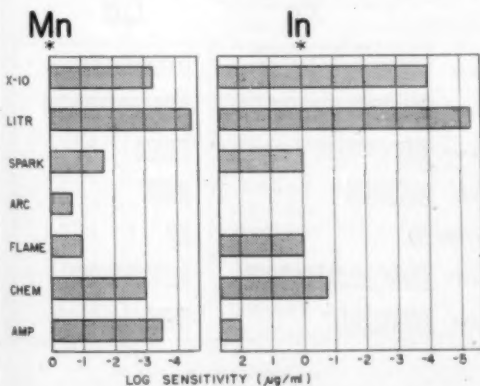


Fig. 6. Comparison graphs for manganese and indium.

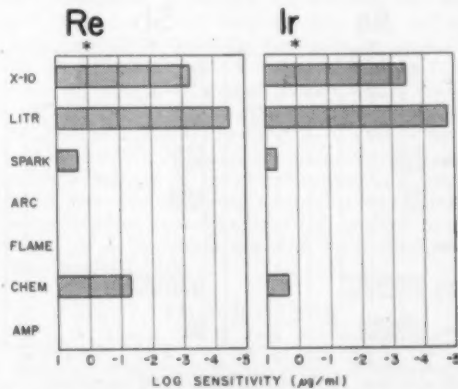


Fig. 7. Comparison graphs for rhenium and iridium.

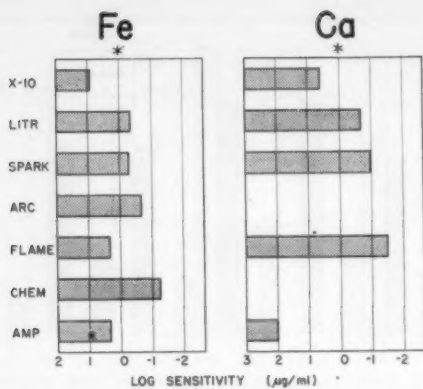


Fig. 8. Comparison graphs for iron and calcium.

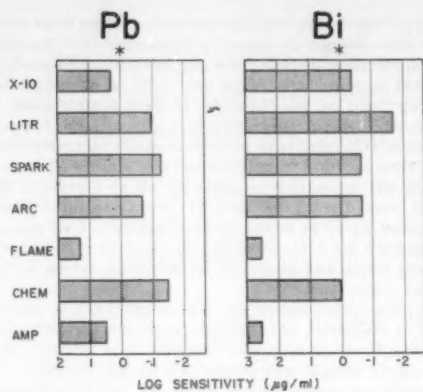


Fig. 9. Comparison graphs for lead and bismuth.

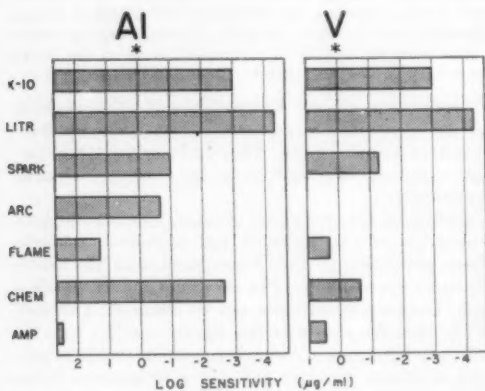


Fig. 10. Comparison graphs for aluminum and vanadium.

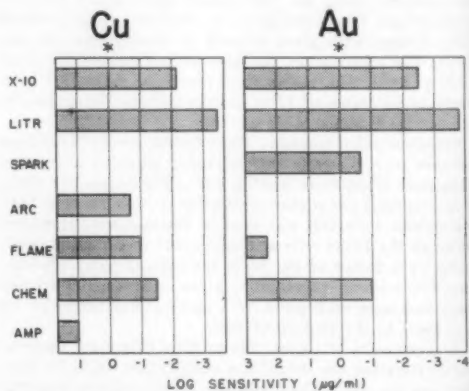


Fig. 11. Comparison graphs for copper and gold.

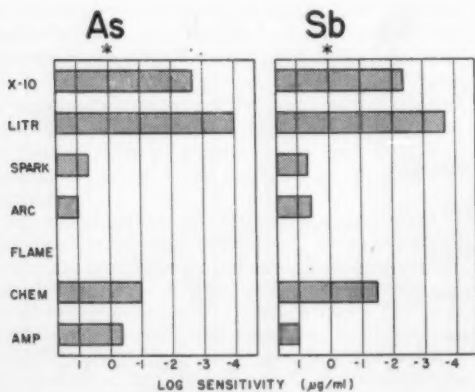


Fig. 12. Comparison graphs for arsenic and antimony.

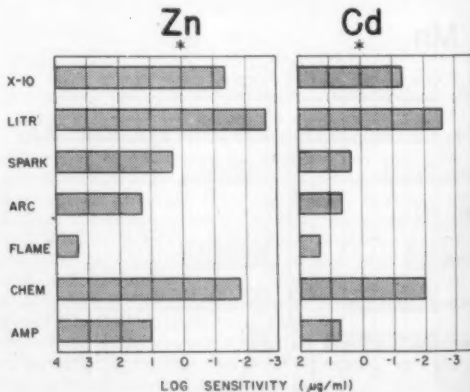


Fig. 13. Comparison graphs for zinc and cadmium.

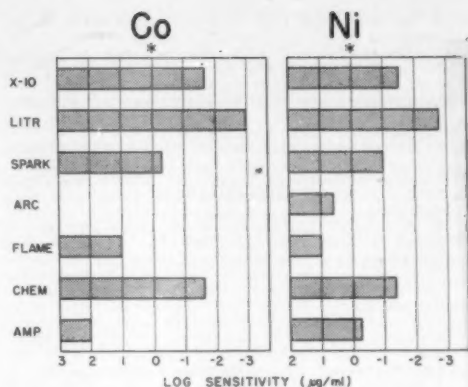


Fig. 14. Comparison graphs for cobalt and nickel.

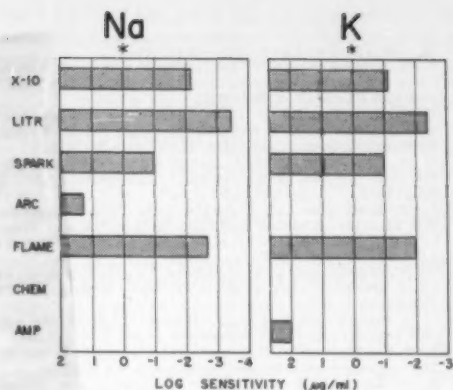


Fig. 15. Comparison graphs for sodium and potassium.

of Fig. 1. The sensitivities for these elements are plotted in Figs 6 and 7. The stars on the graph under the symbol of the element indicate the zero point on the log sensitivity scale. Although activation analysis is very sensitive for manganese, the coulometric method of Furman and the spectrophotometric method using 4,4'-tetramethyldiaminotriphenylmethane give almost equivalent sensitivities. For indium, on the other hand, the other methods are not as highly developed, and activation would prove very useful. Activation would also prove invaluable for both rhenium and iridium, since other methods available at present prove unsatisfactory for highest sensitivity.

Figures 8 and 9 show comparison graphs for iron,

calcium, lead, and bismuth, all of which show poor sensitivity for activation analysis. For analysis of these elements, it would be inadvisable to use activation unless some special condition required it.

Figures 10, 11, and 12 show graphs for aluminum, vanadium, copper, gold, arsenic, and antimony, all of which show good sensitivity for activation analysis. Activation does not present enough advantage over conventional methods to warrant its use for copper and aluminum, but for the others it may provide some advantage.

Figures 13, 14, and 15 show graphs of several other elements that are either neighbors in the periodic table or are in the same family. For each the activation sensitivity is only fair but in some cases the method would be advantageous.

Table 3 lists the chemicals that are reported to give the sensitivities indicated for the sensitive-color-reaction method on the graphs of Figs. 6-15.

Summary. Rough comparisons of the sensitivity of activation analysis with other standard methods give the investigator a feel for the elements for which activation can be used as a powerful tool. Although improvements in technique for an entire method or for an individual element will invalidate the figures given in Table 2, the over-all picture will be changed only slightly. Furthermore, other considerations such as speed of analysis, interferences of other elements, and availability of analyzing instruments and facilities may indicate the use of one method in preference to another. The increasing availability of nuclear reactor facilities, however, means that analysis by activation is an important new tool for general use in trace analysis (21).

References and Notes

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Table 3. Reagents for high sensitivity color reactions (19).

Element	Reagent
Mn	4,4'-Tetramethyldiaminotriphenylmethane
In	8-Hydroxyquinoline
Re	Thiocyanate-stannous chloride (ether solution)
Ir	IrCl ₄ ⁻
Fe	o-Phenanthroline
Ca	
Pb	Dithizone (CCl ₄)
Bi	Phenyldithiobiazolonethiol
V	Benzoylphenylhydroxylamine
Cu	Dithizone (CCl ₄)
Au	o-Tolidine
As	Molybdate-hydrazine sulfate
Sb	Rhodamine B
Zn	Dithizone (CCl ₄)
Cd	Dithizone (CCl ₄)
Co	Nitroso R-salt
Ni	Bromine-dimethylglyoxime
Na	
K	
Al	Oxine

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The Scientist as a Citizen

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SCIENTIFIC meetings in general, and particularly medical meetings, are rightfully dominated by the philosophy of René Descartes, who provided a guiding spirit in the 17th century when he wrote:

I am sure that there is no one, even among those who make it [medicine's] study a profession who does not confess that all that men know is almost nothing in comparison with what remains to be known. I judge there was no better provision against a short life or lack of experience than faithfully to communicate to the public the little which I should myself have discovered, and to beg all well inclined persons to proceed further and then to communicate to the public all the things which they might discover in order that the last should commence where the preceding had left off, and thus by joining together the lives and labors of many, we should collectively proceed much further than anyone in particular could succeed in doing.

But the present complicated problems of our world—a world in which conflicting ideologies threaten the very existence of what we call Western Civilization, and a world in which scientific specialists are fortunate to be able to meet in an atmosphere free from government restrictions, military censorship, or the security surveillance of secret police—call for more than a dedication of our intellects and our labors to mankind.

In order that we may continue as a free society, every person must know and follow the basic principles of responsible individualism that have made our present achievements possible. The present technologic era began sometime in the 18th century, when wealth and science were united amid the clamor of men and women who since the Renaissance had regained their will to be free from political and spiritual enslavement.

A new man was created and mass production became the order of the day. The artisan became a specialist in labor and virtually became part of a machine. In the process of this metamorphosis he lost much of his imagination and creativeness. Such a man is restless because he has no impelling objectives in life. He fears the future because his talents are limited; he looks to society for his rights, and in so doing, he is in danger of losing his obligations. He avoids "travel along the road, and is attracted to the Inn," as Cervantes puts it, where he can sit with self-satisfaction because he has no goal—no place to go.

Ortega was proud but somewhat alarmed at his Spanish countryman who, instead of merely pointing the way, readily escorted the inquiring foreign visitor to the point of inquiry, and thereby left a favorable impression of extreme courtesy. Ortega wonders if this act was a sign of national pride, or was it in reality a sign that his countryman had no mission in

life, and therefore welcomed the opportunity to have one, to travel on the road, and not sit in the Inn. He suspects the latter has gripped the minds of many of his fellow men in all countries.

That is the brief story of the artisan who became a specialist in labor and some of his relationships with society. How did the scientist fare as the result of the 18th century marriage with wealth? A new type of scientist was eventually created. He too was engulfed in the surge of technicism because his effectiveness in this union with wealth depended upon the degree of his specialization, and hence his interests became "gradually restricted and confined into narrower fields of occupation." By the late 19th century he found that he could not survive on the broad philosophic concepts as Goethe had—biologist, physicist, chemist, botanist, playwright, poet, producer, and for 60 years the chief political adviser to Karl August, Duke of Weimar.

The new scientist is a specialist in science. Physics and chemistry have become a multitude of subspecialties. The scientist's learning continues; his technical skill becomes high; but his liberal education diminishes. He becomes entrenched so deeply in the intricacies of his specialty that the social problems of daily life seem unimportant; but the people hold him in high regard, and therefore he feels compelled to express opinions on subjects beyond his experience. The force of his words upon society is in direct proportion to the name he has made in his specialized field—a power so great that it is frightening. In some countries he has already paid a heavy price for his high position of specialized learning. Of the many examples, I shall recall only a few.

An Associated Press dispatch from Leipzig, Germany, dated 11 Nov. 1933, said

In picturesque Leipzig, University German Professors, in an Armistice Day meeting, appealed to the intelligentsia of the world today for a better understanding of Germany. It was their way of urging popular support for the Nazi government in tomorrow's elections.

It is impossible to believe that these professors fully understood the objectives of the National Socialist Party of Germany, or if they did, they were already the political victims of demagoguery.

Also, in 1933, a brilliant scientist, a young man 25 years of age, who had received his doctorate at the University of Leipzig, "left Germany on the rise of Hitler." He probably made no public statement at that time, and if he had, no one would have been impressed, but any statement he makes today is considered impressive news throughout the world. His name is Edward U. Teller, "the man who, by many, is considered the chief architect of the hydrogen bomb."

These incidents constituted the backdrop for a modern tragedy in which the leading character was a world-renowned scientist, J. Robert Oppenheimer, an important member of an international team whose

contribution to the world was the technologic interpretation of Einstein's equation. No human being can accurately evaluate the impact of this technologic interpretation upon the future of mankind, but the best available opinion is probably that of Einstein himself. When he was asked what weapons would be used in World War III, his answer was that he did not know, but that he did know what would be used in World War IV—sticks and stones.

Oppenheimer was judged by a jury of his peers—all men of note and distinction—a chemist, a man of business, and an educator. The majority opinion judged him a loyal citizen of the United States, but unable to measure up to the requirements of the security system. With no intention to judge, but with only the hope to explain, it is my belief that their judgment was correct but their premise was wrong. He should have been found guilty only of a defection, one which he acquired inadvertently as a result of his scientific provincialism. Oppenheimer paid the supreme penalty of dishonor, an awful price to pay, for his subconscious vow of political celibacy.

Who knows how many brilliant and potentially productive minds will be stunted for fear of similar reprisal because they do not understand the true meaning of this indictment? What must be done to prevent another such catastrophe? Is the advice offered by Teller an adequate solution?

Referring to the Oppenheimer judgment, Teller told William L. Laurence of the *New York Times* that "scientists as a group should stay out of politics except in areas touching on science." Today his statement makes impressive news. Has he, too, become a political hermit? Should he not have warned his fellow scientists that such a course is fatal to the free life? Our founding fathers who wrote the Constitution of the United States and the Bill of Rights certainly did not sanction political hermitage.

Scientists seem to have forgotten that as Ortega said, "politics is much more of a reality than science, because it is made up of unique situations in which man suddenly finds himself submerged, whether he will or no."

In a republic the politician reflects the will of the people—the majority; but the majority may accept such things as penicillin and television as commonplace, and yet become indifferent to the cause of their existence. It is the minority, and not the majority, who challenge truth and create new concepts. Freedom in a republic exists only as long as the majority recognizes that the minority must be free to pursue thought, wherever it may lead.

Is it not incumbent upon every one of the 750,000 scientists of this country, and those in every other nation, to be able and willing to speak out clearly on the basic concepts of freedom? By virtue of the natural process of the years of rigorous academic selection, those who finally emerge as true scientists admittedly must have superior minds. If they will not speak out, who will?

Medicine was also an outgrowth of this technologic era—a coalition of the physical and biological sciences. Again, we look with gratitude to Europe—to France for the stethoscope and internal medicine, immunology and radium; to Germany for the x-ray, medical microbiology and pathologic anatomy; to Austria for obstetrics; to England for general surgery and the antibiotics, just to mention a few nations. All of Europe surging forward—free to study, to learn, to think, to imagine, to have ideas, and to be rewarded, as, in the words of Bacon, “The ancients assigned divine honors to the authors of inventions.”

We in America developed slowly, making most of our contributions after the beginning of the 20th century.

We take particular pride in having harnessed, through clinical pathology, the many uncoordinated outgrowths of laboratory medicine into a cohesive unit that has become invaluable to the sick. During the last 30 years the number of clinical pathologists in this country has increased tenfold, from 200 to 2000. Members of the International Congress of Clinical Pathology represent a total of 14 clinical pathology societies in 12 countries—mute testimony to the growth of this important specialty.

In the United States clinical pathology occupies a position of such magnitude that, although it has not yet attained independent status in all schools of medicine, no hospital in the United States can be accredited by the Joint Commission on Accreditation and no hospital approved for intern or resident training without an adequate clinical pathologic service.

Medicine and its broadest subspecialty, clinical pathology, are truly the products of the free minds of many lands, who “by joining together the lives and labors of many,” have made this meeting possible and the world a much better place in which to live.

We are indeed fortunate that whatever may be revealed in the field of medicine will be free for the use of all mankind, regardless of political affiliations, religious convictions, or national boundaries. Medicine does not hoard its achievements. No true physician has ever patented a medical discovery. No one has ever denied its use by friend or enemy; only armed conflict between nations with differing political beliefs has ever imposed restraints upon the results of medical investigation. Even then, the individuals who waged war, who were enemies only by accident, ministered to the sick and wounded, whether they were friend or foe.

But what assurance do we have that medicine will continue to remain outside the domain of security regulations, secret police, political restraints, and the like?

In countries outside the iron curtain, even where varying degrees of government control hover over medical practice, there are few restraints upon the individual physician who seeks truth wherever he may find it, and gives freely of his labors to mankind. The only assurance we can have that this privilege to serve will continue is an enlightened citizenry who

understands the principles of individual liberty and creativeness.

Because of the intimate contact with the ills of men, physicians have gained an enviable position of respect and confidence among men. This trust obligates them to become disciples of the philosophy of individual freedom in order that patients do not become apathetic to the cause of the miracles of modern medicine.

Are physicians capable of accepting this responsibility? Or will they become political eunuchs? To what degree has specialization forced the physician to abandon a continuing pursuit of a liberal education and led him into the false security of political and scientific provincialism?

In order to answer these questions it may be well to review the educational background of the average medical man in the United States. A tabulation of the premedical educational requirements for admission to 78 schools of medicine in this country shows an alarming degree of concentrated training in the sciences. Approximately four times as many semester hours are required in science subjects as are required in the humanities. It is of more than passing significance, and I believe planned foresight, that only one school in the United States requires more hours of study in the humanities than in the sciences. That school is Meharry University, whose student body is composed entirely of Negroes.

Add to the premedical schooling 4 more years of medical education, 1 year of internship, and 3 to 4 years of resident training in a medical specialty, and 2 years in the military, also in medicine, and you have a supersaturated, learned young man, 31 to 33 years of age, with almost pure scientific instruction throughout 14 of the most formative years of his intellectual growth. One saving factor is that he is intimately exposed to people and their problems—more closely than any other man, with the possible exception of the clergyman.

Pathologists have a solemn role in medical education, whether it is for nurses, medical technologists, medical students, interns, residents, or the medical staff. In this role lies the opportunity to broaden the educational base of medicine, in order to preserve the right of every physician to continue his scientific pursuits unhampered lest we become so engrossed in our own special field that we forget to look after the common good.

We must reject the philosophy of self-content, expressed by Hegel in 1831, but which is still heard in our day:

Let us content ourselves with what we have been allowed to achieve under the pressure of the circumstances . . . and with the doubt . . . whether amid the loud clamour of the day, there is left any room for sympathy, with the passionless stillness of the science of pure thought.

We can and must meet the challenge of the janiceps of modern living—the science of the daily life as well as the science of pure thought.

Theodore Lyman, a Pioneer in Far Ultraviolet Spectroscopy

THEODORE LYMAN, professor emeritus of physics in Harvard University, whose death occurred on 11 October in his 80th year, came of an old well-to-do family distinguished for philanthropy and public service. His father was a marine biologist, a student under Louis Agassiz, once a member of Congress, and always a devoted friend of Harvard. Born in 1874 in Boston, Lyman attended various schools before entering Harvard in 1893. In some notes which he wrote he said that the selection of his schools was "governed more by the degree to which they suited my feeble health than by any considerations of the quality of instruction which they afforded." His uncertain health was a handicap from which he was never entirely free. This prevented him from taking part in any athletic pursuits, and may have produced in him a certain shyness or reserve. He once playfully said in connection with Radcliffe College that he approved of the education of women but wished it to take place at some distance from where he was. Under the same heading, perhaps, belongs the fact that he never married. He had, however, many friends and he was a member of several clubs. He was always a delightful guest and a most gracious host.

To those who worked with him Lyman showed a warm and friendly personality. The staff of the Jefferson Physical Laboratory of which he was the director were devoted to him. He was respected for his judgment, honored for his achievements, and loved for his kindness and generosity. Few knew of his many benefactions. On a larger scale he was a donor to hospitals and to Harvard itself. When it came to planning the new research laboratory that now bears his name, it was he who worked for years to raise the necessary funds and who contributed largely in money, time, and strength.

During his teens Lyman had an interest in chemical experiments and mechanical devices, but it was not until his years in Harvard that he began to devote himself to physics. There he fell under the influence of Wallace C. Sabine, especially in his optics course, which interested Lyman greatly. He must have done well, for he was invited to return as a graduate student, and then took on a research subject, suggested by Sabine, that occupied him for the rest of his active life—the exploration of the far ultraviolet spectrum.

V. Schumann had already discovered a spectrum of hydrogen so far out that the rays would not pass through air. Schumann had used a prism vacuum spectrograph but could not measure wavelengths. Sabine suggested that Lyman make a vacuum spectrograph with a grating in it. Lyman made an ingenious mounting furnished with two slits, with which he could photograph simultaneously different parts of

the spectra of different sources on a plate. One spectrum was displaced by the distance between the slits, and when this distance was measured the wavelengths of the unknown spectrum could be found from those of the known one. Lyman's first paper was about the false lines produced by this grating, and their origin in irregularities in the ruling of the grating. He then measured the hydrogen spectrum, including the lines of the atomic series now often known by his name, and the lines that are given by the molecule of hydrogen. Later on he measured a great many other spectra, and found the strongest lines that form the simplest series for helium. His early work was limited to a range of wavelengths from 2000 to nearly 1000 Å. After the war he pushed the outer limit down below 500 Å. He also examined the transmission of gases and solids in this region, and the reflection of many solids. He discovered that for the shortest wavelengths a glass grating was better than a metal one, provided that the rays reflected from its surface were used. His list of 33 published papers shows a very extensive study of his field. There is also one paper on the sterilizing action of these rays, and others on diffraction and the luminescence of various substances exposed to them. His book entitled *Spectroscopy of the Extreme Ultra-violet* appeared in 1914, with a second edition ten years later.

While carrying on his research he climbed the academic ladder to the top, becoming Hollis professor of mathematics and natural philosophy in 1921. He was chairman of the physics department for about 15 years, and director of the Jefferson Physical Laboratory for 30 years. He won the Rumford medal of the American Academy of Arts and Sciences, and served as president of that academy for one term. He was also president of the American Physical Society, and won the Elliott Cresson medal of the American Philosophic Society, and the Frederick Ives medal of the Optical Society of America. He became a fellow of the National Academy of Sciences in 1917. He was also a fellow of the Royal Institution and of the Royal Geographical Society.

In the first World War he attended two voluntary military camps, was adjutant of the Harvard Training Corps, and went to France in 1917 as a captain in the Signal Corps to develop flash and sound ranging. There he soon had charge of a training school in this technique, and then, from April 1918 until the end of the war he was in charge of a flash ranging unit at the front, serving in three battles, including the critical operations on the Marne in June and July. He returned in March 1919 as a major in the Second Army in charge of a battalion of more than 1000 officers and men. He spoke of this military service as

one of the "durable satisfactions" of his life, but he placed his experimental research ahead of it.

For many years he took long trips during his summer holidays. These took him to Japan, Korea, British East Africa, the Altai Mountains in Siberia, and Alaska. He also hunted in our Northwest and in British Columbia, and fished in the Gaspé Peninsula. Some of these trips had a scientific tinge; one, in particular, had as its goal the collecting of ticks from the bodies of mountain goats, which acted as vectors of Rocky Mountain Spotted Fever. Each of these expeditions served to renew his health for the next academic year.

In May 1930 while on a boat to England he was stricken with a ruptured appendix and spent the summer in a hospital. On his return he had to submit to a corrective operation. The whole experience

was so severe that he never completely recovered from it. Nevertheless he continued research at a reduced pace, and still carried administrative responsibilities for several years.

His ability to drive himself against the drag of bodily ailments was realized by only a few of his friends. In the notes on his life that have been used for this article he says that he is struck by the number of hours of hard work he has been able to get out of a very imperfect system—that is, himself. The driving power came from within, and is the more impressive when we consider that he never had the spur of being compelled to earn money. Not many men in his circumstances would have labored so devotedly for the advance of pure science as he did.

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News and Notes

A Return to Reason

A very significant article has been published in the July-August issue of *Transactions (Izvestia) of the Academy of Sciences of U.S.S.R* [No. 4, Biological Series (1954), pp. 97-120]. Nothing like it has appeared in the U.S.S.R. since August of 1948. It is a review by V. I. Kremiansky on "Certain problems of general biology in modern Western literature. On the status of Morganism." The sense of the article is that Morganism (alias genetics) has made important advances in recent years. Although still not quite acceptable, genetics has evolved in the right direction.

The bibliography of Kremiansky's review contains more than 250 references to recent genetic literature, including some work of authors whose names were not mentioned in the U.S.S.R. for several years. Much attention is devoted to the research on the genetics of microorganisms, adaptive enzymes, physical and chemical mutagens, the problem of crossing-over, chromosome chemistry, cytoplasmic inheritance, heterosis, polyploidy, and chromosomal variations in natural populations. Another review of the modern Western literature concerning evolution is promised to follow.

The review covers so wide a field that Kremiansky's descriptions and comments are of necessity terse but usually to the point. He obviously knows what he is writing about. This does not mean that modern genetics has for him much validity. He is quite skeptical about the theory of the linear arrangement of genes in chromosomes. The concepts of genotype and of norm of reaction are not even mentioned, and the observations of Monod and others on adaptive enzymes are interpreted (though not without hesitation!) as showing inheritance of acquired traits. The high frequency of inversions in populations of many species of *Drosophila* is, curiously enough, taken to contra-

diet the continuity of the chromosomal organization. However, Kremiansky's disapproval of these fundamentals of genetics is based on arguments other than that they disagree with the dicta of Michurin or Lysenko or that they were invented by a wrong sort of people.

Most geneticists will agree that the concepts of this science have changed a great deal during the last 20 years or so. But this is a doubtful warrant for the statement:

It is no exaggeration to say that if anybody wanted now to return to the theoretical views of 1936-1937, this would be impossible because in place of the old 'fortress' (of genetics) there remain only scattered building blocks—facts without a general theory.

Few geneticists ever thought in terms of "fortresses," and many of them, certainly including the late T. H. Morgan, found a great pleasure in changing "general theories." Similarly overstated is the supposed contrast between the "old" and the "new" genetics given by Kremiansky in a tabular form at the end of his review. But however much one may disagree with Kremiansky about these and other points, his opinions could be profitably discussed and argued with. His closing sentences are worth quoting in full:

The present state of Morganism is characterized by negation of the old rather than by affirmation of the new. This is an earmark of crisis of a scientific theory. Nevertheless, the direction of change in this field is already clear. Essentially, this is toward the rejection of the theoretical bases of the Morganism proper. This has been unavoidable. Science cannot reconcile itself to distortions of what is objectively valid.

To this last the Morganists will say "Amen."

I am indebted to I. L. Kosin, Washington State College, Pullman, for having called my attention to

Kremiansky's article, and to Leo Grulow, of the *Digest of the Current Soviet Press*, Columbia University, for the loan of the publication itself.

THEODOSIUS DOBZHANSKY

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Problems of Comparative Behavior

A seminar on *Problems in Comparative Behavior* was held, with the support of the National Science Foundation, in the Psychological Laboratories, Harvard University, 5-15 July 1954. The seminar was aimed at bringing together for free and informal interchange of experimental data and theoretical problems a small group of active ethologists, neurophysiologists, psychologists, and zoologists. Over the past twenty-odd years two groups of students of animal behavior have been working along parallel lines, but in very little contact with each other. They have, nonetheless, emerged with remarkably parallel findings in both data and theoretical constructions.

The first group includes experimental psychologists who have been objectively studying learning and motivation, sometimes in primates, usually in small mammals (especially the white rat), and latterly, in the pigeon. These psychologists have laid stress on the problems associated with the acquisition of new behavior, and the laws governing such acquisition. The second group is made up largely of zoologists, among whom is a very active subgroup, productive of theory, called ethologists. These men have been objectively studying instinctive behavior, usually of a number of varieties of birds and fish. They have stressed the dependence of behavior on genetic and evolutionary variables.

Superficially, the two groups might be expected to show little convergence in either problems or interests although they both define their fields as "the science of behavior." This is not the case. If one examines the yield of the experiments and observations that have been performed by the two groups, it falls into three classes: conclusions peculiar to the ethologists, conclusions peculiar to the psychologists, and conclusions common to both. The third class is remarkably large. More interesting, it is the third class of finding that has determined to a great extent the theoretical structures evolved. In fact, one can demonstrate not only that the two groups share their basic theoretical concepts (to the extent that their technical vocabularies are composed of words that both use, or that are readily translatable), but also that the kinds of theories they have evolved from the data are alike in content, even though they deal respectively with "learned" and "instinctive" behavior.

On examination, the other two areas of research, the areas peculiar to the experimental psychologist and those peculiar to the ethologist, prove to be largely complementary to one another. No contradictory assertions, empirical or theoretical, arise in them, but rather statements about the action of variables

neglected by the members of the other group. These variables, neglected though they have been, are of importance to the behavior examined by both groups. The "reinforcing stimuli" of comparative psychologists occur in the execution of "instinctive behavior," and the "displacement activities" of the ethologists are observable in the T-maze and in the Skinner-box.

Both groups have somewhat ambiguous relationships with a third group—those neurophysiologists who deal with the internal events that are presumed to be correlated with behavior. Once again, there are areas that overlap or complement each other. But the relationships are somewhat different. Many ethologists emphasize the importance of achieving a neurophysiological model for behavior, and usually try to construct one; however, they seem to lack the experimental tools and the detailed information that are necessary to make one that is verifiable. At the same time, many comparative psychologists deprecate such attempts at theoretical formulations, sometimes without inquiring into the neurophysiological data that may be available. They stand for "psychology without physiology" (as a minority of ethologists propose "ethology without physiology"). Neurophysiologists, on the other hand, engaged in active research on the functioning of the central nervous system, seem to work with either of two points of view—first, studying electrical and other activities as they depend on direct manipulation without reference to behavior, and second, finding whatever events they can that are correlated with behavior. Unfortunately, behavioral data suited to the needs of the neurophysiologist are scanty and inappropriate; the great bulk of them are of no use because of the choice of variables or species. Willy nilly, neurophysiologists are often forced to deal with neurophysiology without behavior.

The three groups, then, share a broad area of knowledge, and at the same time have each developed special areas peculiar to themselves, though highly relevant to the work of the others. It was thought, then, that an opportunity for free exchange of data, points of view, and techniques, would familiarize members of each group with the work of others (a purpose which, unfortunately, the journals do not seem to serve as well as they might), and might clarify and define the extent of overlap among the fields, so that a more coherent, fuller set of data on behavior would be available to each. Eventually the neurophysiologists' potential contribution may be more fully realized, and purely contextual and verbal differences between ethologists and psychologists in their experimental and theoretical treatment of behavior may be minimized.

The meetings at Harvard were organized and ran by a committee of five, consisting of: Frank A. Beach, Harry F. Harlow, C. F. Pribram, W. S. Verplanck (chairman), and Carroll M. Williams. Participants were invited to bring data and reprints for exchange, and to be prepared to talk informally for about an hour on such of their own recent work, experimental or theoretical, as they believed would be of interest

to the group. Whether or not the material had been published was of no concern. It proved new to the majority of the group. The group met morning and afternoon. On each day, two or three members of the group talked. The speakers were so scheduled that the first of them spoke on topics close to the area of overlap of most members of the group, the later ones on the more specialized topics of their own areas.

These informal reports served to set off the vigorous discussions hoped for; discussions usually took their points of departure from issues specifically raised by the report, although there were frequent returns to topics that had been taken up earlier. The meeting established that most of the problems raised, both experimental and theoretical, were shared by all the fields represented. Moreover, the views expressed by various members of the group, though often in conflict, did not separate the members of the group according to the field they represented. An ethologist, a psychologist, and a neurophysiologist often found themselves disputing a point with an "opposition" made up also of an ethologist, a psychologist, and a neurophysiologist. And, unusual in such discussions, more light than heat was generated.

It may be of interest to list the topics about which the most provocative (and longest lasting) discussions rotated: (i) clarification of the meanings and connotations of terms, for example, what is meant by *innate* and *learned*; what psychologists mean by *learning*; (ii) the role of theory, and the use and abuse of experiment in "verifying" theory; (iii) various aspects of the similarities and divergences of specific concepts among the fields represented; (iv) the role of evolutionary theory in biology and psychology; (v) neurophysiology and its current usefulness in the explanation of behavior; (vi) *drive* and *motivation* (two much abused words); (vii) current theories of learning.

This list is not exhaustive, nor were the discussions. In fact, these tended to center on specific issues, and hence to avoid the less fruitful generalities.

This seminar was planned as a series of free discussions, without formal papers. It was designed to establish a community of ideas among a group of people working on much the same subject matter. It was designed not only to make communication possible, but also to stimulate active communication, mutual interest, and hence, implicitly, an exchange of problems and techniques. It was a highly successful meeting with respect to these ends.

The consensus of the group, at its last meeting, was that this seminar had been of unusual interest to its members, that it had been especially stimulating and informative, and that its small size and compatible membership, its informality, and the absence of any obligation to prepare formal papers, publishable or not, had been very important to its success. The results of the conference from these points of view suggest that other such conferences, held in various fields, may be worthy of support in the future.

WILLIAM S. VERPLANCK

Harvard University Psychological Laboratories

Science News

An article appealing for greater freedom in Soviet scientific research and for open competition among rival schools of scientific thought was published in January in the journal *Literaturnaya Gazeta* by academicians Ivan L. Knunyants and L. Zubkov. Knunyants, a chemist, is an important figure who has won three Stalin prizes and made a number of discoveries, one being the invention of the Soviet equivalent of nylon. Obviously with the Lysenko genetics case in mind, [*Science* 109, 404 (22 Apr. 1949); 111, 389 (14 Apr. 1950)], the authors say that

... the aspirations of any one school toward a monopoly in science should be suppressed with all the force of public authority. . . . Only under conditions of free exchange of ideas, in discussions, in criticism and self-criticism, does vital creative thought pulsate, do the results obtained receive correct evaluation, are new and fruitful scientific ideas conceived.

The article states that the low level of some Soviet scientific discussions also hinders normal relations between Soviet and foreign scientists. The Russian scientific attack on "the great progressive scientist, Prof. L. Pauling," is mentioned with the comment that, though Pauling's contributions to the theory of resonance in chemistry had been correctly criticized, the general scientific value of his research had been "unjustly called into question."

The approach to better relations with foreign scientists follows a trend that has been observed in several fields. For instance, the resolutions of the All-Union Congress of Soviet Writers published recently in Moscow included these three reflections of the trend: (i) they emphasized the importance of wider exchange of information and publications among writers of different countries; (ii) they instructed the newly elected board of the Union of Soviet Writers to promote the "widest translation of the best works of modern writers of all countries into the languages of the peoples of the U.S.S.R.;" and (iii) they called for an international meeting of writers in 1955, organized "on the basis of the widest possible representation."

A 9-yr-old legal controversy over the tax status of a chemist operating an analytical laboratory in New York has been decided in favor of the chemist. Because his case was of interest to the entire profession, the American Chemical Society supported Abraham Mirkin against the New York State Tax Commission. According to New York State law, professional men engaged in the practice of their profession are exempt from taxes imposed on unincorporated businesses. In 1946 an exemption was claimed by Mirkin, whose Mirkin Analytical and Pathological Laboratories are at 230 E. 12th St., New York. The claim was rejected on the ground that his laboratory activities did not constitute the practice of a profession. The Tax Commission has now handed down a decision supporting Mirkin's position.

The research vessels *Atlantis* and *Caryn* left Woods Hole, Mass., on 19 Jan. on the first leg of a 4-mo cruise to the Caribbean Sea. The vessels, working in tandem, will sail in and out among the Caribbean Islands to study the geology of the islands and to obtain data on the fertility of the Caribbean Sea.

At Bermuda the ships will load quantities of explosives that will be used in acoustic sounding to obtain knowledge of the rockbed below the sea bottom and of the thickness of the overlying carpet of sediment. An echo recorder, developed at the Woods Hole Oceanographic Institution and capable of measuring the depth of the sea to within 1 to 2 ft at an over-all depth of approximately 20,000 ft, has been installed on the ships. Charles B. Officer, Jr., geophysicist, will be the chief scientist during the work in the West Indies. Until he joins the *Atlantis* in St. Thomas, V.I., the ships will be under the leadership of acoustical expert Henry R. Johnson.

The special features of an unusual scientific retreat, the **Center for Advance Study in the Behavioral Sciences, Inc.**, built on a hilltop near Palo Alto, Calif., are described in the January *Architectural Forum*. The center, headed by Frank Stanton, president of Columbia Broadcasting System, and financed and endowed by the Ford Foundation, will be open to selected scientists and specialists who wish to utilize their sabbatical leaves in quiet, concentrated study of man, analyzing his underlying motivations, influences, and behavioral patterns.

The establishment has a motel-type arrangement: groups of small, completely private study buildings surround a cross-shaped central building; each peripheral unit is placed on the slope of the hill so that it will not obstruct the view of any unit above. The central building has large meeting rooms, a dining area, library, and administration offices. The buildings are frame, simple in the extreme, and for the most part constructed of redwood.

The date of early man's first permanent settlement apparently has been pushed back before 5000 B.C. by the discovery of the site of another prehistoric settlement in Iraq by archeologists of the University of Chicago's Iraq-Jarmo Expedition now at work in the Middle East. Robert J. Braidwood, professor of Old World archeology in the university's Oriental Institute and director of the expedition, reports that exploratory digging has uncovered a prehistoric settlement even older than the village of Jarmo, until now thought to be the oldest settled village.

The new settlement, considerably smaller and more primitive than Jarmo, is located at M'lefaat, 25 mi east of Mosul in northeastern Iraq near the Iranian border. Test diggings indicate that in prehistoric times a small permanent settlement of "pit houses," pits with floors and hearths but without walls, existed there. The pits may have been covered with tents, or even with sod as are our western sod houses.

The inhabitants apparently had no pottery, but had

good flint tools and heavy ground-stone mortars, pestles, rubbing stones, and axes. No sickles were found in the test diggings, which indicates that the inhabitants of M'lefaat had not yet begun to cultivate grain. Finds of fragmentary clay figures show that the people had begun to mold clay figures although they had not yet learned pottery-making.

Main object of the Iraq-Jarmo expedition, a joint project of the Oriental Institute and the department of anthropology, is the study of civilization in the Middle East in the period 7000-10,000 yr ago. The area explored covers about 2400 mi². The staff has traveled more than 400 mi, chiefly on foot, but also by collapsible boat on the Zab River and its tributaries.

Members of the group in addition to Braidwood include: Bruce Howe, archeologist from Harvard's Peabody Museum, in charge of the affiliated operations of the Baghdad School of the American Schools of Oriental Research; H. E. Wright, Jr., University of Minnesota geologist; Frederick R. Matson of Pennsylvania State University, specialist in radioactive carbon dating technology; and Charles A. Reed, University of Illinois zoologist. Hans Helback, botanist from the Danish National Museum, will join the expedition shortly. The expedition is financed by the University of Chicago and the American Schools of Oriental Research, and by grants from the American Philosophical Society, the Natural Science Foundation, Guggenheim Foundation, the Wenner-Gren Foundation for Anthropological Research, and by private donors.

The 50th anniversary of the U.S. Forest Service was commemorated this month by a golden anniversary dinner sponsored by the American Forestry Association and the Society of American Foresters. The Forest Service was created in its present form in the U.S. Department of Agriculture on 1 Feb. 1905 during the administration of President Theodore Roosevelt, through merger of the earlier Bureau of Forestry and the forestry division of the General Land Office. Gifford Pinchot was the first chief forester.

The American Forestry Association is a citizens' organization of 25,000 members, formed in 1875. The Society of American Foresters, an organization of 10,000 professional foresters, was established in 1900. Both have their headquarters in Washington, D.C.

In a forthcoming technical article on the **leukemogenic effects of ionizing radiation** on atomic bomb survivors in Hiroshima, William C. Moloney and Mervin Kastenbaum present evidence leading to the following conclusions. (i) Among the survivors age and sex have no measurable effect on the incidence of leukemia. (ii) The incidence of leukemia is higher for those who were closer to the hypocenter than for those farther away at the time of the bombing. (iii) The incidence of leukemia is much higher for those with significant radiation complaints than for those with no significant radiation complaints. (iv) The difference in the incidence of leukemia between the group with and those without significant radiation complaints is not depend-

ent on the distance from the hypocenter. At all distances where cases of leukemia have been found, the incidence of leukemia is higher among the group with significant radiation complaints. (v) It seems apparent from these observations that in man the leukemogenic dose of single total-body ionizing irradiation must be high and is probably in the order of 200 r. (vi) Following the Hiroshima atomic bomb explosion, the neutron flux, as evidenced by biologic effects, was apparently much more extensive and heavier than hitherto estimated. Neutron activity may have been an important leukemogenic factor in atomic bomb survivors.

From 20 to 26 Feb. engineering societies throughout the country will observe **National Engineers' Week**, which is sponsored by the National Society of Professional Engineers, Washington, D.C.

The National Science Foundation has agreed to accept governmental responsibility through fiscal year 1956 for the **Federal rubber research program**. This action will carry out one of the recommendations included in a report that has just been submitted to the Congress by the Rubber Disposal Commission. All of the RDC's recommendations become final unless disapproved by Congress within 60 days.

Alan T. Waterman, director of the NSF, has indicated that the foundation will, as soon as possible, enlist the aid of expert scientific and technical advice in making a thorough review and evaluation of the existing research programs. The rubber research program, which is at present administered by the Office of Synthetic Rubber of the Federal Facilities Corporation, consists of two parts: (i) a basic research program conducted by contract with nine educational institutions and three research organizations; and (ii) a laboratory owned by the Federal Government at Akron, Ohio, and operated under contract with the University of Akron.

A rich **uranium field** has been located near Carcoar, 193 mi west of Sydney, in the province of New South Wales, Australia.

The United States ranks 13th among the national standards organizations of 34 nations in degree of participation in **international standards work**. George F. Hussey, Jr., vice admiral, U.S.N. (ret.), managing director of the American Standards Association, in a report compiled on international standards work for 1954, pointed out that the United States is still lagging far behind other countries.

The United States member of the International Organization for Standardization is the American Standards Association. Through this association the United States holds secretariats of eight technical committees and participates in international standards work in such fields as mechanical, metallurgical, textile, rubber, and plastic industries; in the building trade; photography and motion pictures; and in many other areas, including for instance standards for hospital stretchers and transfusion equipment.

France leads the United States in international standards work by participating in $2\frac{1}{2}$ times as many ISO committees as this country. The French Standards Association takes part in 79 of the 80 committees of the International Organization for Standardization. The United Kingdom, which participates in the work of 72 committees, leads in the number for which it serves as the secretariat nation. It heads 18 committees. Other countries with heavy participation in standards work are the Netherlands (75 committees), Germany (71), Italy (60), and Belgium (57). Russia's participation in the work is 15 percent more than that of the United States.

Scientists in the News

A memorial lecture honoring the late **Lewis John Stadler**, professor of field crops at the University of Missouri and geneticist for the U.S. Department of Agriculture, was held at Columbia, Mo., on 3 Feb. A foreword was given by Henry E. Bent, dean of the graduate faculty, on "Dr. Stadler's contribution to the University of Missouri," and a lecture on "Gene structure and gene function" was presented by George W. Beadle, president of the AAAS and chairman of the division of biology at California Institute of Technology.

The lecture was arranged under the auspices of the University of Missouri chapters of Sigma Xi and Gamma Sigma Delta and will be published by the university, together with a complete bibliography of Stadler's scientific papers.

Dirk Brouwer, Munson professor of natural philosophy and astronomy and director of the observatory at Yale University, will receive the two highest honors of the Royal Astronomical Society of Great Britain. He has been named the society's George Darwin lecturer and the recipient of its gold medal. He will go to England this spring for a presentation ceremony and to deliver the Darwin lectures. Earlier this year Brouwer was awarded a U.S. Educational Exchange grant for study and research in Australia; he will leave for that country next summer.

Charles Watson-Munro, professor of physics at Victoria University College, Wellington, New Zealand, has been named head of Australia's Atomic Energy Commission. One of his first responsibilities in his new post will be to direct the building of a \$12-million reactor. He was instrumental in the construction of Britain's first atomic pile, and he also directed control equipment for the first Canadian pile.

On 25 Jan. **Hendrik S. van Klooster**, since 1925 professor of physical chemistry at Rensselaer Polytechnic Institute, retired. Except for a 5-mo leave during World War II as a member of the Alsos mission, he has been connected with the institute for 36 yr. He expects to spend some time in travel, both here and abroad.

Among those to receive the U.S. Department of the Interior's highest honor, the distinguished service award, are the following.

Irwin B. Hosig, "upon retirement after an eminent career in engineering with the Bureau of Reclamation for more than forty-nine years, the longest service on record for the Bureau."

Edward I. Loud, Jr., "in recognition of fifteen years of outstanding service in the Geological Survey."

John D. Northrop, "in recognition of more than forty years of outstanding service with the Geological Survey."

Harold S. Kennedy, "in recognition of an eminent career of approximately thirty-five years of outstanding service in the furtherance of the helium program of the Bureau of Mines."

Walter I. R. Murphy, "in recognition of outstanding scientific contributions to the advancement of petroleum and oil-shale technologies in furtherance of the efficient utilization and conservation of these natural resources."

Vernon F. Parry, "in recognition of outstanding scientific and technical contributions . . . in the field of coal processing."

Stephen M. Shelton, "in recognition of outstanding leadership in metallurgical research in the Bureau of Mines."

John S. Ball, "in recognition of outstanding research on the composition of petroleum and shale oil."

Jesse L. Nusbaum, "in recognition of outstanding service in the preservation of archeological sites on Federal lands."

Richard D. Leitch, "upon retirement after thirty-three years of outstanding service in reducing hazards and promoting safety in the Bureau of Mines."

Ralph A. Tudor, Under Secretary, "for outstanding public service."

A. E. Whitford, director of the University of Wisconsin's Washburn Observatory, is taking leave during the second semester to visit the Mount Wilson and Palomar Observatories in California, where he will further his research on the light of distant galaxies.

The American Society of Civil Engineers has announced the establishment of the **Ernest E. Howard** award in honor of the late past president. Mr. Howard, senior partner of the Kansas City, Mo., and New York firm of Howard, Needles, Tammen and Bergendoff, consulting engineers, died on 19 Aug. 1953. The award, which has been made possible by funds donated by his widow, will be made annually "to recognize a civil engineer who has made a definite contribution to the advancement of structural engineering through either writing or performance."

Philip Veneziano has joined the staff of Northwestern University, Evanston, Ill., as a research associate in experimental embryology. Veneziano was formerly a chemist with the Water Resources Division, U.S. Geological Survey, in Austin, Tex.

Alexander A. Wolsky, former professor of zoology at the University of Budapest and director of the Hungarian Biological Research Institute at Tihany, has been named professor of experimental embryology in the department of biology at Fordham University. For 6 yr prior to this appointment, Wolsky was with UNESCO as principal scientific officer for southeast Asia. He is the author of *Genetics and the Origin of the Species*, *Biological Lexicon*, and many other scientific works.

Linwood A. Walters, a specialist in research and development in the resins and plastics field since 1940, has been appointed development manager of the Durite department of the Borden Company's chemical division. A graduate of the University of Florida in chemical engineering Walters aided in the development of thermosetting molding materials for the Bakelite Corp.

Orren D. Chapman, a member of the department of microbiology at New York State University College of Medicine, Syracuse, has arrived in Amman, Jordan, where he will remain 2 yr on commission from the U.S. Public Health Service assigned to FOA as chief of cooperative health and sanitation in Jordan.

Three scientists and Science Service, Inc., received the 1955 awards of the American Meteorological Society.

The award for extraordinary scientific accomplishment went to **Jerome Namais**, chief of the U.S. Weather Bureau's extended forecast section for his "contribution to, and stimulation of, research in the principles and application of extended and long-range forecasting techniques."

Charles F. Brooks, director of Harvard University's Blue Hills Observatory, Milton, Mass., who organized the society in 1919, was honored for his lifetime of service to the society.

Horace R. Byers of the University of Chicago received an award in appreciation of his service as society president during 1953-54.

Watson Davis, director of Science Service, Inc., accepted the award for his organization, which was cited for its "extensive coverage and accurate reporting of current developments in theoretical and applied meteorology."

Two scientists of the U.S. Department of Agriculture's Eastern Regional Research Laboratory in Wyndmoor, Pa., have retired. **Jerome S. Rogers** served the Government for 26 yr, and **Elias Yanovsky** for more than 30 yr. Rogers, who received a B.S. degree from Syracuse University in 1907 and an M.S. degree from the University of Illinois in 1909, was head of the hides, tanning materials, and leather section. His 45 yr in leather research began in 1909 when he entered the USDA's former Bureau of Chemistry as a junior chemist. He left the bureau in 1918 to work in the leather manufacturing industry. In 1937 he

returned to Government service in the Bureau of Chemistry and Soils in Washington, D. C., where he joined a group of scientists working on leather and tanning materials. He was transferred to the Eastern Regional Research Laboratory with this team in 1941, and in 1945 was made head of the group. He is author or coauthor of 53 publications. He has served successively as council member, vice-president, and president of the American Leather Chemists Association.

Rogers is succeeded by **Sam R. Hoover**, a member of the staff since 1939. Formerly supervisor of the denaturation and hydrolysis unit of the protein division, he has conducted fundamental research on casein and other milk proteins.

Yanovsky, a specialist in carbohydrate chemistry, was born in St. Petersburg, Russia, and received his undergraduate training in chemistry at the University of St. Petersburg. He came to the United States as a young man and earned his doctor's degree at Clark University in 1913. After a brief period in industry he, too, joined the staff of the USDA Bureau of Chemistry. In 1918 he resigned to engage in industrial research and later to establish his own laboratory. In 1929 he returned to Government research in the carbohydrate division of the Bureau of Chemistry and Soils. In 1943, when the bureau was decentralized, Yanovsky was transferred to the carbohydrate division of the Wyndmoor Laboratory, where he conducted research on allyl starch and other starch derivatives and on the chemical composition of potatoes. As the time of his retirement he was in charge of the potato composition unit of the fruit and vegetable section. Yanovsky is author or coauthor of some 50 publications and patents. He was leader of the group that won the USDA Superior Service award for developing allyl starch, a varnishlike substance that can be made from potatoes.

Benjamin Thomas, a geographer at the University of California, Los Angeles, has just returned after a year's absence during which he traveled more than 18,000 mi in Africa studying recent developments in trade and transportation, on that continent. His work was sponsored by the Office of Naval Research.

Lyndon E. Lee, Jr., former director of cancer control for the Puerto Rico Department of Health and professor in the University of Puerto Rico School of Medicine, is now director of surgery at the Wayne County General Hospital and Infirmary, Eloise, Mich. He retains his affiliation with his Puerto Rican offices as a consultant.

Thomas J. Kehoe, former senior associate with Pomeroy and Associates, Consulting Engineers of Pasadena, Calif., has been appointed application engineer for Beckman Instruments, Inc. He will travel extensively and will be concerned principally with industrial pH in the waste and process control fields and in flow colorimetry.

Necrology

William J. Agnew, 63, retired deputy chief of the Navy's Bureau of Medicine and Surgery, San Diego, Calif., 25 Jan.; **Isaac A. Bigger, Jr.**, 61, author, editor, chief of the surgical services at the Medical College of Virginia, Richmond, Va., 27 Jan.; **Raymond Clark**, 85, former clinical professor of medicine and chief of medical service at Long Island College Hospital, New York, 23 Jan.; **Joseph Felsen**, 62, pathologist, authority on dysentery and ulcerative colitis, author, director of laboratories and research at Bronx Hospital, New York, 27 Jan.; **Edgar G. Hill**, 71, engineer, authority on natural gas, retired vice president and director of Ford, Bacon & Davis, Inc., New York, 20 Jan.; **Edgar S. Kennedy**, 57, director of textile research for the American Viscose Corp., Philadelphia, 23 Jan.; **Leon J. Menville**, 73, past president of the Radiological Society of North America, author, professor emeritus of radiology at Tulane University Medical School, New Orleans, La., 24 Jan.; **Ernest C. Moore**, 83, educator, author, retired professor of education and philosophy at the University of California, Los Angeles, 23 Jan.

Meetings

On 1-2 Mar. the first **International Congress on Air Pollution**, sponsored by the American Society of Mechanical Engineers, will take place at the Hotel Statler in New York. Theme of the meeting will be *A New Frontier—Air Pollution Control*. A special feature that has been arranged is the presentation of the Calvin W. Rice lecture by Hugh E. C. Beaver, chairman of the British Government committee of inquiry that is investigating the London smog of 1952. The technical program has been published in *Mechanical Engineering* [76, 1048 (Dec. 1954)].

The **Montana Academy of Sciences** will hold its annual meeting at the Montana School of Mines in Butte, 15-16 Apr. Inquiries may be addressed to Leroy H. Harvey, Dept. of Botany, Montana State University, Missoula.

An attendance of 40,000 is expected for the 1955 **Institute of Radio Engineers** national convention to be held 21-24 Mar. in New York. There will be 55 technical sessions and 704 engineering exhibits, covering almost every new development in communications and electronics. The centers of activity will be the Waldorf-Astoria Hotel, Kingsbridge Armory, and Belmont Plaza Hotel. The radio engineering show exhibits will fill the 4-acre floor of the armory and overflow into the Kingsbridge Palace, 1½ blocks away.

Among the features of the convention will be the annual meeting of the I.R.E. on the opening morning, which will feature a talk by A. V. Loughren, director of research for the Hazeltine Corp., and the annual I.R.E. banquet at which Matthew B. Ridgway, Chief of Staff of the U.S. Army, will be the principal

speaker. The technical program will be highlighted by two special symposiums *Magnetic Recording for the Engineer* and *Trends in Automatization of Procedures and Processes in Business and Industry*. The remainder of the program will cover a wide variety of topics such as spurious radiation, remote control of space stations, and designing machines to simulate the behavior of the human brain."

Approximately 250 educators, representing 16 medical schools, 8 dental schools, 115 liberal arts colleges, and 8 professional societies and educational foundations in the New England and Middle Atlantic states attended the **Conference on Premedical and Predental Education** held in New York on 7-8 Jan. Sponsored by Alpha Epsilon Delta, the national premedical honor society, the conference was devoted to a discussion and evaluation of the findings and recommendations of the Severinghaus Committee on Preprofessional Education of the Survey of Medical Education, which were recently published as a report entitled *Preparation for Medical Education in the Liberal Arts College*.

A definite effort was made to explore ways and means by which the results of this survey could be used constructively by the medical, dental, and liberal arts colleges to improve the program of premedical and predental education. A summary of the conclusions of the round-table discussion groups will be published in *The Scalpel* of Alpha Epsilon Delta and a copy may be obtained on request to the society, 7 Brookside Circle, Bronxville 8, N.Y.

An **International Symposium on Electrical Discharges in Gases** will be held at the Technical University in Delft, Netherlands, 25-30 Apr. The following speakers have accepted invitations to give featured lectures: H. S. W. Massey, London, "Fundamental primary processes in gas discharges"; L. B. Loeb, Berkeley, Calif., "Field measurements in glow discharges with a refined electron beam probe and automatic recording"; Chr. van Geel, Delft, "On the internal self-induction of gas discharges"; S. C. Brown, Cambridge, Mass., "Breakdown in gases at microwave frequencies"; M. A. Biondi, East Pittsburgh, Pa., "Microwave and optical techniques for gas discharges"; W. Lochte-Holtgreven, Kiel, "Arc discharges"; J. M. Meek, Liverpool, "Spark discharges."

The languages to be used are English, French, and German; however, English will be preferred for the discussions. Inquiries should be addressed to the secretary of the symposium committee, Ir A. W. van Wagenveld, Mijnbouwplein 11, Delft, Netherlands.

Animal caretakers and users of experimental animals from all parts of the United States and several foreign countries gathered in Chicago at Northwestern University for the meeting of the **Animal Care Panel**, 1-2 Dec. In 16 technical papers and related discussions they heard the latest methods of animal procurement, disease control, housing, and utilization.

Jan Schwartz of the Jewish Hospital Association, Cincinnati, revealed that internal fungus infections in

animals are much more prevalent than previously believed. These infections have been missed because of difficulty in making diagnoses. Schwartz explained that specific skin tests can be helpful in making preliminary diagnoses and that serologic tests may be of confirmatory value, but a positive culture is the only reliable proof of a fungus infection. The common fungus diseases of laboratory animals are actinomycesis, histoplasmosis, blastomycosis, sporotrichosis, and coccidiomycosis.

Common street or barn pigeons are playing very important roles in experimental research, W. F. Hollander of Iowa State College reported. The pigeons are used in nutritional and endocrine physiology, psychology, disease and parasite vector studies, genetics, embryology and feather development analysis, and immunology. A motion picture showing animal care facilities in some British medical research laboratories was shown by D. J. Short of The British National Institute for Medical Research.

The Institute for Fluid Dynamics and Applied Mathematics of the University of Maryland, in cooperation with the Office of Scientific Research, Air Research and Development Command, will hold a conference devoted to **differential equations**, ordinary and partial, 17-19 Mar. Programs are available on request.

Some 25 leading educators in college **physics, mathematics, and mechanics** met at New York University, 23-26 Jan., to try to make room in the current 4-yr engineering program for courses in nuclear physics and solid state physics. The conference was conducted by N.Y.U. and the American Society for Engineering Education under a grant from the National Science Foundation. Results will be referred to the A.S.E.E. for action at its annual meeting in June.

Society Elections

American Society of Hospital Pharmacists (to be installed in May): pres.-elect, Claude Busick, Stockton, Calif.; v. pres.-elect, Milton Skolaut, Bethesda, Md.; treas.-elect, Sister Mary Rebecca, Ogden, Utah.

American Pharmaceutical Association (to be installed in May): pres.-elect, John B. Heinz, Salt Lake City, Utah; first v. pres.-elect, Troy C. Daniels, San Francisco, Calif.; second v. pres.-elect, George C. Roberts, Greenwood, Miss.

The **International Commission on Zoological Nomenclature** has announced the election of the following members of the Commission:

K. H. L. Key, principal research officer, Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Canberra, A.C.T., Australia, succeeding Joseph Pearson, resigned.

Alden H. Miller, professor of zoology and director of the Museum of Vertebrate Zoology, University of California, Berkeley, succeeding J. L. Peters, deceased.

Ferdinand Prantl, vice-director, Národní Museum, Prague, Czechoslovakia.

Wilhelm Kühnelt, professor, Zoologisches Institut der Universität, Vienna, Austria.

F. S. Bodenheimer, professor, department of zoology, Hebrew University, Jerusalem, Israel.

Ernst Mayr, Alexander Agassiz professor of zoology at Harvard College.

Enrico Tortonese, professor of zoology, Istituto e Museo di Zoologia, Università di Torino, Italy, succeeding Lodovico di Caporiaceo, deceased.

The American Ornithologists' Union: pres., Alden H. Miller, Museum of Vertebrate Zoology, University of California; 1st v. pres., Ludlow Griscom, Museum of Comparative Zoology, Harvard University; 2nd v. pres., Ernst Mayr, Museum of Comparative Zoology, Harvard University; sec., Harold F. Mayfield, 2557 Portsmouth Ave., Toledo 13, Ohio; treas., Charles G. Sibley, Cornell University; editor, Robert W. Stroer, Museum of Zoology, University of Michigan.

Education

Emory University announces the organization of a program of graduate studies in the recently formed Division of Basic Sciences in the Health Services; the division includes the departments of anatomy, bacteriology, biochemistry, pharmacology, and physiology. Students are admitted to the division rather than to departments, and the program of graduate studies and research of the student is directed by a committee with representation from all the departments. Additional features of the program are a tutorial system for each student, a program of divisional faculty-student seminars for the consideration of topics of interest to all departments, and a program designed to give the student experience and training for teaching in any of the departments.

The Division of Basic Sciences was formed by the consolidation of the professional school departments into single university departments. The division is a primary faculty unit of the university; Arthur P. Richardson is the director.

The Tissue Culture Association is again sponsoring a course of instruction in the principles and techniques of cell and tissue culture. The course will be under the direction of Charles M. Pomerat, University of Texas Medical Branch, and will be given in the laboratories of the Mary Imogene Bassett Hospital, Cooperstown, N.Y., 2-27 Aug. Tuition will be \$100.

The five basic methods of cell culture are employed in the laboratory work. The morning work includes a review of the principles and techniques pertaining to the main event of the laboratory work and a demonstration of the procedures to be used. Each participant prepares and manages his own cell cultures. Afternoons afford opportunity for library work and for consultation with the staff concerning the projects

contemplated by each of the class members. Evening lectures to broaden horizons are given by members of the staff and by distinguished guest lecturers.

The course is designed specifically for postgraduates (M.D. or Ph.D.) who plan to use cultured tissues in their research or teaching. Requests for application forms should be addressed to Dr. Mary S. Parshley, College of Physicians and Surgeons, 630 W. 168 St., New York 32, and should be completed and returned to her not later than 1 May.

The 20th session of the Norelco x-ray Diffraction School for research and industrial registrants who can visit the New York City area will be held at the plant of North American Philips Co., Inc., 750 South Fulton Ave., Mount Vernon, N.Y. during the week of 4-8 Apr. Registration will be limited to 125 persons for the first 4 days and to 150 on Friday, the day devoted to actual application problems when guest speakers discuss methods currently in use by researchers and industrial plants.

The evening division of Adelphi College, Garden City, N.Y., is expanding its course of study. A new program leading to the bachelor of science degree in general studies—with concentration in the sciences—is open for enrollment immediately. Twelve science concentration courses will be offered this spring in conjunction with the program. They may be selected from the fields of biology, chemistry, mathematics, and physics.

Applications for enrollment in the 1955-56 session of the Oak Ridge School of Reactor Technology (ORSORT) are now being accepted. Enrollments for the 50-wk course, which begins in September, will close on 14 Mar. The school is a part of Oak Ridge National Laboratory, which is operated for the Atomic Energy Commission by Union Carbide and Carbon Corp. Industrial organizations may enroll a limited number of their technical personnel in ORSORT. The Atomic Energy Commission, aware of the growing need for competent nuclear reactor engineers, has made this participation possible to encourage nuclear progress in industry. The tuition is \$2500 for students from industrial firms other than AEC operating contractors. Additional information may be obtained from the Director, Oak Ridge School of Reactor Technology, P.O. Box P, Oak Ridge, Tenn.

The Cape Haze Marine Laboratory, a new marine biological station, opened at Placida, Fla. in January. Situated on Gasparilla Sound, it offers opportunities for studying the fauna and flora of the Gulf of Mexico to both senior investigators and students. The laboratory is the first part of a cultural center planned for Cape Haze by William H. and Alfred G. Vanderbilt. A museum collection of local fishes and facilities for keeping living specimens are also features of the development. Director of the laboratory is Eugenie Clark, research associate, American Museum of Natural History.

Available Fellowships and Awards

The Committee on Disaster Studies of the National Academy of Sciences-National Research Council in its last meeting emphasized the need to encourage research by competent representatives of the social sciences and related disciplines who wish to advance knowledge in their own fields and contribute to the solution of disaster problems. The committee is interested in the effects of disaster upon individuals, groups, communities, and societies; human response to the threat and impact of disaster, ranging from the individual to the national level; the human aspects of such problems as communications, warning organization, rescue, welfare, medical care, evacuation, and logistics; and the long-term effects and recovery problems of disaster.

The committee can support this development to a limited extent by providing financial assistance for investigations and analyses. Assistance will be similar to grants-in-aid and will normally range from \$200 to \$2000. Projects requiring larger sums, those that are especially meritorious and pertinent to the committee's interests, can be considered. Proposals from graduate students, faculty members, and other qualified investigators will be entertained. Inquiries should be directed to the Committee on Disaster Studies, Division of Anthropology and Psychology, National Academy of Sciences-National Research Council, 2101 Constitution Ave., Washington, D.C.

The Medical Library Association has approved two scholarships of \$150 each to be offered in the 1955 summer course on Bibliography of Bio-Medical and Physical Sciences at the University of Southern California School of Library Science. Similar scholarships were announced earlier at Columbia and Emory universities. These scholarships are the first such to be offered on the West Coast.

The course lasts from 20 June to 29 July. It consists of selecting, evaluating, and using books and specialized reference and bibliographic tools in biomedical and scientific literature. For application blanks and further information, write to Acting Director, School of Library Science, University of Southern California, Los Angeles 7.

Case Institute of Technology is offering 50 General Electric science fellowships to preparatory- and high-school teachers of physics from north-central states for a special 6-wk study program. The fellowships, sponsored by the General Electric Co., are open to qualified teachers from the following states: Illinois, Indiana, Iowa, Kentucky, Michigan, Missouri, Minnesota, Ohio, Western Pennsylvania, Tennessee, West Virginia and Wisconsin.

Applicants must be college graduates, possess experience in preparatory- or high-school science teaching, and be certified to teach in their respective states. The all-expense fellowship program will run from 19 June to 20 July. Funds will cover living expenses

on the Case campus, books, tuition, fees, and traveling expenses to and from Cleveland, Ohio. Applications may be obtained from Dean Elmer Hutehison, Case Institute of Technology, 10900 Euclid Ave., Cleveland 6, Ohio.

In addition to the study program at Case, G.E. will also offer summer courses for high-school mathematics teachers at Rensselaer Polytechnic Institute; a summer program for high-school mathematics teachers at Purdue University; and summer courses for secondary-school chemistry and physics teachers from northeastern states at Union College.

The Grass Trust for Research in Neurophysiology will provide one or two fellowships for work at the Marine Biological Laboratory at Woods Hole, Mass., during the summer of 1955. The stipend will be \$500 to \$1000, depending upon the financial needs of the candidate. Two candidates may apply jointly to work together with stipends of \$500 each. The fellowships are designed for young investigators in the predoctoral or early postdoctoral stage. Applications may consist of a brief letter, preferably from some senior investigator who knows the candidate well, describing his qualifications and giving a brief account of his plans for research and how he would use this fellowship. Reprints of published work will also be helpful to the selection committee. Letters and supporting material in triplicate should be sent to Dr. Robert S. Morison, Room 5500, 49 W. 49th St., New York 20. The closing date for applications is 1 Mar.

Francis W. Davis, inventor of power steering for automobiles, has established a Lionel S. Marks Fellowship Fund at Harvard University to honor a professor "who made his students work hard and made them enjoy it." Mr. Davis, a member of the Harvard Class of 1910 who studied mechanical engineering with Prof. Marks, called his \$50,000 gift "a token of my high regard and friendship for an inspiring teacher and a great personality." The new fellowship will provide support for graduate study of mechanical engineering in Harvard's division of engineering and applied physics.

The Marks fund actually was established some weeks before Prof. Marks' sudden death in January. Prof. Marks, an authority on engine design and editor of the widely used *Mechanical Engineer's Handbook*, retired from the Harvard faculty in 1940 after 46 yr of teaching.

With support from the National Heart Institute, the U.S. Public Health Service, and the American Heart Association, the Medical College of Georgia, Augusta, is offering a 12-mo postgraduate cardiovascular research and training program in its departments of physiology and pharmacology. The program is under the direction of W. F. Hamilton, department of physiology, and R. P. Ahlquist, department of pharmacology. Graduates in medicine or related sciences who are recommended and who are acceptable to

the program directors will be appointed for 1 yr, effective 1 July 1955, to the faculty rank of research associate. The stipend is \$3400 with an additional \$350 for each dependent. For additional information and application forms, write Dr. W. F. Hamilton or Dr. R. P. Ahlquist, Medical College of Georgia, Augusta.

A national competition for fellowships for **high school teachers** of chemistry, physics, and biology throughout the United States and Canada to attend a special program at Massachusetts Institute of Technology during the summer has been announced. Generous assistance from the Westinghouse Educational Foundation will make possible a total of 50 fellowships of \$250 each to help meet the costs of attending a special program. This program, from 27 June to 5 Aug., will provide a review of fundamental subject matter in physics, chemistry, and biology, and a survey of recent scientific developments not only in these fields but also in meteorology, geology, and aeronautical engineering. Further information on the Science Teachers' Program, and application blanks for the Westinghouse fellowships may be obtained from the Summer Session Office, Room 7-103, Massachusetts Institute of Technology, Cambridge 39, Mass. *All applications must be filed by 1 Apr.*

For the summer of 1955 10 National Science Foundation predoctoral scholarships will be offered for course or research work at the **Duke University Marine Laboratory**, Beaufort, N.C. The scholarships are sufficient to cover tuition, board, and room for 6 wk. Graduate students from any university may apply. Selections will be based upon undergraduate and graduate transcripts and three letters of recommendation.

Four postdoctoral grants of \$500 each will be made to biology faculty from colleges and universities of the Southeast, other than Duke University, for 12 wk of research at the laboratory. Inquiries should be addressed to the director, Dr. C. G. Bookhout, Zoology Dept., Duke University, Durham, N.C.

Wesleyan University, Middletown, Conn., will increase its annual stipends for graduate assistants in the sciences from \$1300 to \$1500 in 1955-56. Fellowship grants for graduate assistants will also be raised on a sliding scale from the present \$325 to a maximum of \$600 yearly. There are usually about 18 assistants in residence, both men and women, working toward the master's degree in one of the sciences. Each science department will also make available two \$500 summer research grants for graduate fellows.

Grants and Fellowships Awarded

The following postdoctorate fellows are conducting research in the laboratories of the **National Research Council of Canada**. Only those in their first term of appointment are listed. They represent 42 universities, including 8 Canadian institutions and 34 located in 14 other countries.

D. P. Burina, Calcutta. Div. of applied biology; plant physiology.

A. B. Callear, Birmingham. Div. of applied chemistry; applied catalysis.

R. G. Chambers, Cantab. Div. of physics; low temperature and solid-state physics.

D. M. J. Compton, Oxon. Div. of pure chemistry; photoconductivity of organic crystals.

C. Deb, Calcutta. Div. of applied biology; animal physiology.

A. Y. Drummond, Oxon. Div. of applied chemistry; physical organic.

E. L. Falconer, McGill. Div. of applied biology; carbohydrates and fat chemistry.

E. Fawcett, Cantab. Div. of physics; low temperature and solid-state physics.

A. W. Frank, McGill. Div. of pure chemistry; organic chemistry.

H. Gesser, McGill. Div. of pure chemistry; photochemistry.

E. D. Goddard, Cantab. Div. of pure chemistry; thermochimistry.

T. T. Harding, Nottingham. Div. of pure chemistry; intermolecular forces and physical properties.

E. R. Hardwick, U.C.L.A. Div. of pure chemistry; photochemistry.

K. E. Hayes, Oregon. Div. of applied chemistry, applied catalysis.

T. J. Hugo, Stellenbosch. Div. of pure physics; spectroscopy.

K. Ito, Nagoya. Div. of pure chemistry; molecular spectroscopy.

A. H. Jackson, Cantab. Div. of pure chemistry; organic chemistry.

C. J. D. Jarvis, Edinburgh. Div. of physics; cosmic rays.

S. W. Kennedy, Belfast. Div. of applied chemistry; corrosion.

F. R. Lipsett, London. Div. of radio and electrical engineering; dielectrics.

J. S. Mackie, Aberdeen. Div. of applied chemistry; high-polymer section.

D. G. H. Marsden, Oxon. Div. of pure chemistry; mass spectroscopy.

D. L. Martin, London. Div. of physics; low-temperature and solid-state physics.

T. W. Martin, Northwestern. Div. of pure chemistry; photochemistry.

M. Martin-Smith, New Zealand and Rochester. Div. of pure chemistry; organic chemistry.

D. E. McElcheran, Leeds. Div. of pure chemistry; photochemistry.

D. W. McKee, London. Div. of applied chemistry; applied catalysis.

A. Morgan, St. Andrews, Scotland. Div. of pure chemistry; organic chemistry.

A. Nickon, Alta. and Harvard. Div. of pure chemistry; organic spectrochemistry.

J. V. Ramsay, Sydney and London. Div. of physics; metrology.

G. S. Rose, Birmingham. Div. of pure chemistry; surface chemistry.

H. C. Rowlinson, Oxon. Div. of applied chemistry; applied catalysis.

K. Sargeant, Liverpool. Div. of pure chemistry; organic chemistry.

J. Schmorak, Hebrew Univ. and Geneva. Div. of applied biology; carbohydrate and fat chemistry.

B. A. Stone, Melbourne and London. Div. of applied biology; fermentations and enzymology.

R. L. Strong, Wisconsin. Div. of pure chemistry; photochemistry.

E. J. Tarlton, New Brunswick and Harvard. Div. of pure chemistry; organic chemistry.

H. W. Taylor, Man. Div. of pure physics; cosmic rays.

Y. Ting, Ohio State. Div. of pure physics; spectroscopy.

R. Tremblay, Montreal. Div. of applied chemistry; colloids.

E. Vance, Glasgow. Div. of applied chemistry; high-polymer section.

J. E. Vandegaer, Louvain. Div. of applied biology; biological macromolecules.

P. K. Watson, Birmingham. Div. of radio and electrical engineering; dielectric section.

R. V. Webber, Dalhousie and Wisconsin. Div. of applied biology; biophysics.

G. C. Wood, Leeds. Div. of applied biology; biological macromolecules.

A. Zehnder, Zurich. Div. of applied biology; plant physiology.

In the Laboratories

Ground was broken recently for the \$4 million research laboratories building of the **Missile Systems Division of Lockheed Aircraft Corp.** The first earth was turned on the project when a buried powder charge was touched off by an electronic signal from Lockheed's missile test base at Holloman Air Development Center, Alamogordo, N.M.

Elwood R. Quesada, vice president and general manager of the Missile Systems Division, who telephonically directed his aides in New Mexico to set off the powder blast, said the four-story, 74,000-ft² building is the first step in a long-range plan to develop optimum weapons systems for the nuclear era. Head of the research laboratory is Ernest H. Krause, nuclear physicist, formerly associate director of research at the Naval Research Laboratory, Washington, D.C.

Harris Research Laboratories, Washington, D.C., celebrated its 10th anniversary in December. Organized by Milton Harris, formerly a chemist at the Bureau of Standards, the laboratory was sponsored by the Textile Foundation at its inception. Since then it has broadened its interests to include not only a range of fiber and cosmetic research, but numerous other fields. The laboratory also sponsors research of its own and has developed, patented, and licensed processes for shrinkproofing, bleaching and "stripping" the color from wool. Recently, the organization published the *Harris' Handbook of Textile Fibers*, a compilation of technical and economic data considered the first of its kind in the fiber field.

Hooker Electrochemical Co. of Niagara Falls, N.Y., manufacturers of a diversified list of more than 100 heavy and fine chemicals used in manufacturing and processing, and developers of important polyesters, recently announced merger plans with **Durez Plastics and Chemicals, Inc.**, of North Tonawanda, N.Y. Durez, a producer of phenolic, plastic, and related molding compounds sold to the automotive, electric, packaging, and other industries, would be operated as a division of Hooker, retaining the Durez name. The merger is planned on a share-for-share basis. Hooker observes its 50th anniversary this year.

Miscellaneous

The Engineers' Job Directory, a new annual publication has just been released by Decision, Inc., of Cincinnati, Ohio. Oliver P. Bardes is president and publisher. This is the first guide of its type directed specifically toward supplying job information to young engineers. Some 129 participating companies present key facts about their organizations—year founded, products, number of employees, whom to contact, and so forth. The directory also includes an extensive index. Companies indicate the types of engineers they want—for example, chemical, electrical, mechanical—and another section lists the companies interested in undergraduates for summer jobs.

The report of the **Southeastern Conference on Biology Teaching** held at the University of Florida, 28 Aug.–6 Sept., has been published as the January issue of *The American Biology Teacher*. The 64-page report summarizes the recommendations of the 96 persons in attendance on how to improve biology teaching in high schools and colleges and how state departments of education can assist in the development of strong biology programs, particularly in the Southeast. The conference was sponsored by the National Association of Biology Teachers in conjunction with the annual meeting of the American Institute of Biological Sciences on a grant from the National Science Foundation.

Single copies of the report are available free from Dr. Richard L. Weaver, Co-Director, School of Natural Resources, University of Michigan, Ann Arbor. Those interested in the N.A.B.T. should write to Paul Webster, Secretary, Bryan High School, Bryan, Ohio. Conference reports are being sent to all members.

G. P. Woollard, professor of geophysics at the University of Wisconsin, and G. F. Hanson, Wisconsin state geologist and staff member of the university, are the authors of a report, Bull. 78 in the Wisconsin Geological Survey series, on the solutions of subsurface geologic problems in Wisconsin. The report, "Geophysical methods applied to geologic problems in Wisconsin," is the result of 4 yr of investigations. Its aim is "to show the degree to which geophysical studies can be of assistance in resolving some of the problems of subsurface water supply, mineral exploration, engineering, and subsurface geology encountered in Wisconsin." The bulletin is available through the office of the State Geologist, Science Hall, University of Wisconsin, Madison.

A survey of the nuclear-energy field for industries interested in that area is being distributed this week as the first contribution of the University of Michigan's new industry program. Called *A Peacetime Survey of Nuclear Energy from an Industrial Viewpoint*, the manual is a condensation of information from many unclassified publications as well as from original investigations. It was written by Joseph J. Bulmer and Marx Weech, research associates in the Engineering Research Institute, with the assistance of a third research associate, John G. Lewis, and of Harold A. Ohlgren, professor of chemical engineering, who is in charge of the industry program.

The survey shows where every industry can find a role in the nuclear-power field—the mining and preparation of fuel ores, utilization of power nuclear reactors, use of radioactive materials produced in the reactors, chemical processing of "used" fuels, manufacture of instruments to measure and control atomic energy. At the same time, the study points out the places where industry can expect to encounter difficulties, such as in the handling and storage of intensely radioactive by-products.

Book Reviews

Optical Image Evaluation. Proc. of NBS Symposium held Oct. 18-20, 1951. National Bureau of Standards, Washington, D.C., 1954. x + 289 pp. Illus. \$2.25. (Order from Supt. of Documents, GPO, Washington 25, D.C.)

Because it is a field in which the NBS has been active for many years, the evaluation of optical imagery formed the subject of one of the 12 symposiums held to mark the Jubilee of the National Bureau of Standards in 1954. Included in this volume are 20 contributions by authorities from all parts of the world as well as what appears to be a verbatim record of the discussion which followed each session. Since all communications are printed in clear and readable English, the reader is spared some of the language difficulties which inevitably accompany meetings of international scope.

There are a number of contributions dealing with theoretical aspects of optical image formation, particularly the diffraction theory of aberrations. The bulk of the symposium, however, was devoted to a discussion of the methods and instruments developed in various laboratories to explore the light distribution in images produced by optical systems. Interferometric and photoelectric procedures are described as well as more conventional tests involving resolution and visual judgment. It is obvious that considerable progress has been made in this field and that the experimental results are in turn stimulating further theoretical work. Perhaps the best evaluation of the status of this aspect of optics is given by Irvine C. Gardner in his introduction to the book:

The papers of this symposium touch upon most aspects of the problem in more or less detail but, like most useful scientific work, the papers also suggest the large amount of work that remains to be done.

GERALD WESTHEIMER

School of Optometry, Ohio State University

Plant Regulators in Agriculture. H. B. Tukey, Ed. Wiley, New York; Chapman & Hall, London, 1954. x + 269 pp. Illus. \$5.50.

A need has long existed for a readable, authoritative book dealing with plant (growth) regulators and their practical application in agriculture. Man has sought to manipulate plant growth and development since the dawn of agriculture, yet the sudden advent of chemical regulation, some 20 years ago, was so veiled with mystery that much confusion has resulted, particularly in the minds of those who can best use the findings—the agriculturists.

This book brings together the latest information of the many and varied uses of plant regulators in agriculture. Each aspect was written by a specialist well qualified by training and experience. The whole is correlated and edited by a competent person who

did pioneer work in this field. The terminology used for chemicals is that recently proposed by a committee of the American Society of Plant Physiologists of which the editor was a member. After a brief survey of the nature of plant regulators and the basic concept of plant growth, the information presented pertains largely to application, such as propagation, fruit set, defoliation, blossom thinning, preharvest drop, plant breeding, fruit ripening, sprout inhibition, and weed control. The final chapter is devoted to equipment and methods of application.

Each chapter begins with elementary facts and principles before moving on to more involved and advanced phases. The book avoids routine formulas and oversimplified directions. Instead, basic principles that can be modified to fit local situations are emphasized.

The editor states that the book was written for advanced high-school students, college students, a sprinkling of business and professional men, and county agricultural agents, in particular. To me, this goal has been attained to a high degree.

JOHN C. FRAZIER

*Department of Botany and Plant Pathology,
Kansas State College*

Thermo-Mikro-Methoden. Ludwig Kofler and Adelheid Kofler. Verlag Chemie, Weinheim/Bergstr., ed. 3, 1954. xi + 608 pp. Illus. DM. 39.80.

This third edition is considerably enlarged and revised, partly as a result of the description of newly developed apparatus and identification techniques and partly as a result of the expansion of the tables of properties of individual compounds to include more than 1200 substances.

Those not already familiar with Kofler's book will find in it a definitive and exhaustive treatment of micro methods for the physical identification of organic substances. Excellent theoretical discussions, practical experimental details, and descriptive illustrations are given on the determination and interpretation of melting points, boiling points, refractive indices, molecular weights, and the special properties of crystals. Particularly valuable are the extensions of these determinations to the analyses of multicomponent systems.

Of special interest to the practicing organic chemist is the rapid and convenient method described for characterizing and identifying substances by the melting points of their eutectic mixtures with one or more commonly available organic compounds, such as azobenzene, benzil, acetanilide, and phenacetin.

The typography is excellent and the paper is fair, but the binding is poor.

G. BRYANT BACHMAN

Department of Chemistry, Purdue University

Amphibians and Reptiles of Western North America. Robert C. Stebbins. McGraw-Hill, New York, 1954. xxii + 528 pp. Illus. + plates. \$8.50.

Robert Stebbins' new work on the amphibians and reptiles of the western United States needs only a glance at its superb illustrations and the realization that the drawings are by the author himself to place it beyond comparison among the available handbooks in its field. The book grows naturally from Stebbins' earlier work on the amphibians of the West.

The book is noteworthy for its comprehensive mapping of geographic distribution, species by species. Its emphasis on the *species* as inclusive of its subspecies and the relegation of the discussion of the subspecies to the legends for the maps are still novel and certainly exemplary. The keys for identification have the "key characters" fully illustrated, and thus unequivocally defined. In line with the modern trend in such handbooks, there are references to enable student or amateur to pursue promising lines for further investigation. The introductory matter gives excellent suggestions for collecting and directions for preservation. I should have liked the addition of a section devoted to suggestions for the field and laboratory observation of behavior.

The area included is limited by the state boundaries westward of the Dakotas and Texas, with Canada west of the eastern border of Saskatchewan, and Alaska. This is an effective demarkation, set far enough to the west to exclude most of the distinctive elements of the Appalachian fauna. A few of these easterners have extended their ranges westward into the Great Plains along the water courses beyond the 100th meridian and require a place in the present volume, notably the snapping turtle, the soft-shelled turtle, and the painted turtle. Introduced forms, such as the bullfrog and greenfrog, are included.

Every herpetologist, amateur or professional, should have this work at hand; above all, if he has occasion or opportunity to travel in the West. Every professional zoologist who might be called upon to prepare a handbook on another group of animals or another region, should examine it. Finally, the work is at the level of competence that makes it especially desirable for high-school and college libraries throughout its territory.

KARL P. SCHMIDT

Chicago Natural History Museum

Biochemical Determinants of Microbial Diseases.

René J. Dubos. Harvard Univ. Press, Cambridge, 1954. viii + 152 pp. \$3.50.

Everyone interested in pathogenic microorganisms should read this monograph. It emphasizes "the properties of the infected host which determine the course and outcome of the infectious processes." These properties and processes are defined, insofar as possible, in chemical and physiological terms instead of such vague words as *virulence* and *invasiveness*.

The author has recognized a serious and common shortcoming of most textbooks on infectious diseases, namely, that they dutifully contain a chapter devoted to metabolic chemistry which is not used subsequently in the analysis of reactions between host and bacteria. He documents examples of phenomena which have a bearing on the fate of microorganisms *in vivo* and the biochemical disturbances resulting from infection which may give rise to the manifestation of the disease. A chapter on selected topics in tuberculosis is used to illustrate the range of bacteriological problems that remain to be solved before we understand satisfactorily the pathogenesis of this disease. The compact size of the book (121 pp.) precludes a recitation of many good examples of host-parasite interrelations but the careful choice of tables and references used to illustrate specific points in theory has given a clarity often lost in many longer treatises.

The reference to Table 32 (p. 57) is incorrect and the footnote to this table contains the same error found in the original publication—"aerated with CO₂-free water." No reference is listed for an article cited on page 54. As a whole, the book is well edited.

RILEY D. HOUSEWRIGHT

Medical Bacteriology Department, Camp Detrick

Differential Equations with Applications. Herman Betz, Paul B. Burcham, and George M. Ewing. Harper, New York, 1954. x + 310 pp. \$4.50.

From many points of view this book is a good one and is a welcome addition to the meagre collection of good textbooks for a first course in differential equations for applied scientists. It is replete with a variety of applications including motion of a particle, mechanical and electric oscillations of one and two degrees of freedom, law of mass action, biological genetics, deflection of beams and nonlinear oscillations. Besides the traditional material, the book includes introductory treatments of the Laplace transform, partial differential equations and Fourier series, and boundary value problems.

On the whole, the book is well organized and clearly written with many illustrative examples. It should be understandable to the average engineering or science student. The introductory chapter gives the usual definitions (more about this later) and then first-order differential equations are presented with considerable use of the idea of the direction field. It should be stated that the remark at the bottom of page 16 concerning exact differential equations is incorrect (it makes no difference which integral of Pdx is used). The treatment of implicit differential equations of the first order is unusually well done for a book on this level.

After a well-written chapter on applications, linear equations with constant coefficients are taken up from the operator point of view. The treatment is reasonably complete. The authors regrettably omit any discussion of resonance, although 32 pages are written on

applications of linear equations. In the work on the Laplace transform the subject of the Heaviside function and impulse function are mentioned, but the authors miss a golden opportunity to bring in the superposition integral. Series solutions are given adequate attention, but the special functions are treated in a very cursory manner. The chapter on graphic and numerical equations contains a brief but welcome treatment of Van der Pol's equation. The last portion of the book contains a fairly standard introduction to partial differential equations and boundary value problems.

The main criticism I have is that the authors in their efforts to keep the work elementary and understandable to the applied scientist, have not been too careful in their statements of definitions and restrictions. A good example of this is the introductory chapter where, following the bad tradition of many others, the authors use "fuzzy" expressions like "general solution," "number of distinct arbitrary constants," and the like.

On the whole the book is a good one and should find wide use in first courses for engineers and scientists.

NICHOLAS J. ROSE

*Department of Mathematics,
Stevens Institute of Technology*

Psychomotor Aspects of Mental Disease. An experimental study. H. E. King. Harvard Univ. Press, Cambridge, Mass., 1954 (for the Commonwealth Fund). xiv + 185 pp. Illus. \$3.50.

In the early days of experimental psychology Kraepelin applied its methods to the study of abnormal states. King points out that the experimental study of simple processes that thus began was not really proved useless but rather was lost to view in the appearance of the more spectacular teachings of the psychoanalysts.

Encouraged by the outcome of his previous work on brain-operated patients, King undertook a comparison of several abnormal and normal groups with regard to what are called the fine psychomotor functions. Experiments of this sort require the subject to perform some simple movement or manipulation not requiring much strength on the occasion of the appropriate stimulus. It is well established that such performances, measured for speed and accuracy, do not correlate well with test intelligence in a normal group, nor indeed do they show great correlation with one another. It is usually stated that there is no general psychomotor ability, but it is possible to discern certain groupings of similar tasks from their correlations. By his choice of tasks, King has sampled three of these groupings: "Speed of single reactions," "finger, hand, and forearm speed in restricted oscillating movement," and, "precision." His subject groups are chronic schizophrenes, pseudoneurotic schizophrenes, neurotics, and normals, with the chronic schizophrenes further divided into three groups on the basis of severity of disorder.

His results show a clear, downward progression of average performance in all tasks from the normal through the most disturbed schizophrenes. The differences are quite apparent, ranging up to a 65-percent loss, and their statistical significance is demonstrated by a simple t-test. The tests discriminate well enough between groups to be useful, especially in combination, as diagnostic indicators, and, easy as they are to apply, they might be a standard aid to the clinician.

All the performances tested turn out to vary in a similar way with the severity of behavior disorder. Psychologically it is important that under such a powerful influence the discreteness of psychomotor functions is lost: fundamentally they must have much in common.

As King observes, his results generally agree with and extend the conclusions of a series of experimenters since Kraepelin. One reason that such results have received scant attention is their isolation. It is hard to see how deficiencies in simple reactions are related to the gross behavior disorders of the psychiatric patient. King has a suggestion to offer. He quotes Sperry's proposition:

The entire output of our thinking machine consists of nothing but patterns of motor coordination. Cerebration essentially serves to bring into motor behavior additional refinement.

Such a unified view of behavior would be a bold solution, but King seems unwilling to venture quite so far. His view is that for the lower organisms all behavior is motor behavior and that for human beings motor behavior remains important, although they have, in addition, something called "mentation." This persisting Cartesian division still leaves our theory in a state of schizophrenia. With good reason, therefore, King favors study of the relationship of psychomotor functions to other kinds of behavior, and his work offers proof that it would be fruitful.

R. C. DAVIS

Department of Psychology, Indiana University

The Elementary Chemical Composition of Marine Organisms. Memoir No. 2. A. P. Vinogradov. Trans. by Julia Efron and Jane K. Setlow. Sears Foundation, Yale Univ. Press, New Haven, Conn., 1953. xiv + 647 pp. \$17.

In this monumental work, Vinogradov intended to provide a factual and theoretical basis for and to stimulate interest in the development of marine geochemistry from Vernadsky's biogeochemical point of view. In addition to surveys of the analytical data available for nonplanktonic marine algae, marine plankton, marine bacteria, marine flowering plants, and the marine representatives of each of the major invertebrate phyla, the lower chordates, and fishes, he has included separate discussions of the metal-containing respiratory pigments, of the mineralogical composition of skeletons of marine organisms, of the regulating influence of ocean salt on the chemical

composition of marine organisms, and of the fundamental changes in elementary composition of marine organisms during geological time. Based on the most extensive bibliography of analyses of marine organisms so far assembled, this study also includes much unpublished work from the files of the Vernadsky Laboratory for Geochemical Problems. A work of such scope is of inestimable value to marine biologists, geochemists, sedimentary geologists, comparative physiologists, and students in many other fields, and especially so since it can be assumed that Vinogradov summarized the basic assumptions and the theoretical approaches common to workers at the Vernadsky Laboratory, certainly the major world center of biogeochemical research.

In making this material available to non-Russian-speaking scientists, the translators, bibliographers, and editors have performed a heroic task. The entire text has been brought up to date as of about 1946 and much later material has been added, the bibliography has been thoroughly corrected, all text references have been made specific, and in many sections the taxonomy has been unified and revised. A comparison with some of the author's earlier publications in English indicates that his style has been treated with full justice throughout and that his ideas come through unseathed. One suspects that this volume is now as essential to the Russian workers as to any others.

Considering the enormous amount of effort that it represents, this monograph leaves a regrettably unsatisfactory impression. In a work of such scope it must be expected that specialists will be conscious of neglects of emphasis and of superficialities in discussion; an editorial note points out many cases of conclusions not generally accepted by specialists in the appropriate fields or not borne out by more modern investigations. I feel that too much caution was exercised in retaining in the various tables analyses either obviously untrustworthy or certainly superseded by modern techniques. The occurrences in the discussion of conclusions directly contradicted by the pertinent tables of data may perhaps be blamed on the greater ease of revising tabular material; in any case, such contradictions occur frequently.

As evidence of the theoretical approach of the Russian school of biochemists, one can only deplore the general lack of emphasis on the biology of the organisms being analyzed. Especially striking is the omission of mention of the variability of symbiotic populations of sponges and corals. Unfortunately, too, is the lack of any thoroughgoing attempt to correlate variations in trace-element content with the available data on enzyme activation. The chemical discussion loses force by omitting any consideration of the physical-chemical states of the trace elements in sea water and of the correlated activities of organisms as ion exchangers or colloid adsorbers. It seems unlikely, for instance, that the uptake, as opposed to the metabolism, of arsenate and vanadate can ever be profitably considered apart from that of phosphate.

Regardless of what appear as its many deficiencies

in laying the theoretical groundwork, which was one of its aims, there is a factual basis here for virtually all future investigations into the elementary chemistry of marine organisms and sediments, and we may be sure that the volume will be the major bibliographic starting point for decades to come. As a stimulus to interest, this volume promises to be a success, although the sheer mass of the work may be a major drawback. Gratitude for the elegance and substantiality of the book conflicts in one's mind with horror at the price. Special efforts must be made by librarians to make copies available to the students who should feel and most easily respond to its stimulation.

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Qualitative Inorganic Analysis. A new physico-chemical approach. G. Charlot. Trans. by R. C. Murray. Methuen, London and Wiley, New York, ed. 4, 1954. xi + 354 pp. Illus. \$7.

Like many other textbooks on qualitative analysis, this one is suitable for work on a semimicro scale; it is divided into three parts: "Theory," "Chemical properties and the characterization of ions," and "Technique and methods of qualitative analysis." From this point on, however, the differences are more numerous than the resemblances. Few precipitations are made, and the precipitates seldom require washing. The tests are independent of one another and generally do not require separations of ions as a prerequisite. The author believes that a complete analysis can be made in 2 hr or less. The theory studied in part I is required if the procedures for making tests are to be understood.

About 190 pages in part II are devoted to the properties of, and the tests for, more than 100 substances, mostly ions, about equally divided between cationic and anionic groups. About five pages are devoted to directions for analysis. References are made in part III to descriptions of tests in part II. Tests for 27 cations (37 if multiple valences of some ions are counted) are made on separate samples taken from one solution with only occasional removal of interfering ions as prescribed in special cases. Many tests are by, or are similar to, the spot test. For some tests catalysis or controlled pH and/or redox are prescribed.

The theory is fully as difficult as that presented in the ordinary textbooks on qualitative analysis. The procedures are simpler in that there are fewer procedures before the final test for an ion is made. In fact, many final tests can be made on a 1-drop sample taken from the original solution. All the theory should be mastered; it is necessary to know it before the reasons for the procedures can be understood. However, with an open book one might make a successful analysis without knowing any of the theory. The introduction states that no special knowledge of physical chemistry is necessary since everything that

is required is given in a directly usable form. The equations necessary for expressing relationships are given, but when one meets pH, pK, activity, ionic strength, free energy and redox, formal potentials, buffer solutions, Flood's diagram, overvoltage, distribution coefficient, indicator theory, redox indicators, and pages of equations connecting free energies with various concentrations of oxidants, ions, and complexes, the thought that some knowledge of physical chemistry would be desirable is sure to arise.

The subject matter is logically presented. Binding, printing, paper, and the arrangement of tables, graphs, and illustrations are good. There are minor errors but I saw none worthy of mention. Both the scheme for analysis and the theory necessary for understanding it differ much from those found in the textbooks commonly used in the United States.

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An Introduction to Human Biochemical Genetics.

H. Harris. *Eugenics Laboratory Memoirs, XXXVII.* Cambridge Univ. Press, New York, 1953. 96 pp. Illus. \$2.75.

Because of the difficulties inherent in the study of genetics in humans, knowledge in this area is somewhat less precise than that accumulated through observation of other organisms. On the other hand, in some aspects of genetics, the study of humans has suggested fruitful approaches to be applied to other organisms. This is particularly true of biochemical genetics, since Garrod, studying some diseases which appeared to be "inborn errors of metabolism," was one of the first to see that genes might act through their control over biochemical functions. Since his time, the advent of ever more refined and precise methods for studying the chemical aspects of bacteria, fungi, tissues, and body fluids in humans and animals have made biochemical genetics of considerable scientific importance.

In this book Harris has provided an excellent introduction to this field, which is useful to physicians and medical investigators who would understand genetics, and to geneticists who would see how genetic principles might apply in the biochemistry of health and disease. The book is not long and is certainly readable. Chapters II, III, and IX are especially valuable to the nongeneticist, since they review with great clarity the principles of genetics as they apply to human populations. In Chapter II is a discussion of gene frequencies, the significance of consanguinity, and some of the methods for the analysis of data. In Chapter III Harris discusses the difficult question of heterogeneity of apparently homogenous and simple characters, and in Chapter IX he takes up the problem of variability in manifestation of inherited characteristics. Under this heading are mentioned differences in manifestation in the two sexes, and quantitative differences and variations within and between families.

If one understood what modified the expression of a characteristic in one individual as opposed to another, therapeutic approaches might suggest themselves. The other chapters present well-chosen illustrative material and avoid the use of conditions that are not reasonably well understood.

The format of the book and the diagrams and other illustrations are all well done. This is an important book, illustrating the conception that gene action, in order to be understood with maximum precision, will have to be expressed in biochemical terms.

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General Theory of High Speed Aerodynamics. vol.

VI. *High Speed Aerodynamics and Jet Propulsion.* W. R. Sears, Ed. Princeton Univ. Press, Princeton, N. J., 1954. xiv+758 pp. Illus. + plates. \$15.

This large volume presents discussions of a great variety of problems in high-speed aerodynamics by a number of different authors, each of whom has himself made important original contributions to one or more aspects of the field. This has inevitably resulted in a certain lack of logical structure for the volume considered as a whole. However this defect, if it be one, is more than compensated by the fact that the same subject is frequently considered by several of the authors; the resulting differences in approach and viewpoint are extremely illuminating and helpful to the understanding of the phenomena treated in this multiple fashion. The editorial task of cross-referencing must have been a formidable one, but it has been excellently and very completely accomplished.

The material covered is somewhat less broad than the title would imply since, with very few exceptions, the diffusion of both shear and heat are neglected, and the flows considered are treated as adiabatic. Many of the topics are, for the first time, presented in a unified and comprehensive manner, and there is a considerable amount of new material that has not before appeared at all. Accordingly the volume should be of great interest and value to the rapidly growing group of workers, teachers, and students in the field. The extensive bibliographies at the end of each section should also prove very useful.

Titles and authors of the various sections of *General Theory of High Speed Aerodynamics* are (A) "On the foundation of high speed aerodynamics" by Th. von Karman, (B) "Mathematical aspects of flow problems of hyperbolic type" by K. O. Friedrichs, (C) "Small perturbation theory" by W. R. Sears, (D) "Supersonic and transonic small perturbation theory" by Max Heaslet and Harvard Lomax, (E) "Higher approximations" by M. J. Lighthill, (F) "Plane subsonic and transonic potential flows" by Y. H. Kuo and W. R. Sears, (G) "The method of characteristics" by Antonio Ferri, (H) "Supersonic flows with shock waves" by Antonio Ferri.

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New Books

- Human Physiology.** Bernardo A. Houssay, Juan T. Lewis, Oscar Orias, Eduardo Braun-Menéndez, Enrique Hug, Virgilio G. Foglia, and Luis F. LeLoir. Trans. by Juan T. Lewis and Olive T. Lewis. McGraw-Hill, New York-London, ed. 2, 1955. 1177 pp. \$12.
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- Excavations at Star Carr.** An early Mesolithic site at Seamer near Scarborough, Yorkshire. J. G. D. Clark. With chapters by D. Walker and H. Godwin; F. C. Fraser and J. E. King. Cambridge Univ. Press, New York, 1955. 200 pp. \$11.50.
- Bibliography on Physical Electronics.** Prepared by Wayne B. Nottingham. Research Lab. of Electronics, M.I.T., Cambridge, Mass., 1954 (Distr. by Addison-Wesley, Cambridge, Mass.). 428 pp. \$8.50.
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- Cellular Metabolism and Infections.** Symposium No. 8 of the section on microbiology held at New York Acad. of Medicine 4-5 Mar. 1954. E. Racker, Ed. Academic Press, New York, 1954. 196 pp. \$4.80.
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- The Theory of Spherical and Ellipsoidal Harmonics.** E. W. Hobson. Chelsea, New York, 1955 (Published by Cambridge Univ. Press, New York, 1931). 500 pp. \$4.95.
- Algae and Fungi.** vol. I of *Cryptogamic Botany*. Gilbert M. Smith. McGraw-Hill, New York-London, ed. 2, 1955. 546 pp. \$8.50.
- Modern Aspects of Electrochemistry.** J. O'M. Bockris, Ed. Modern Aspects Ser. of Chemistry No. 1. F. C. Tompkins, Ed. Academic Press, New York; Butterworths, London, 1954. 344 pp. \$6.80.
- Mathematics in Type.** William Byrd, Richmond, Va., 1954. 58 pp. \$3.
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- An Intellectual Primer.** Jay C. Knobe. Philosophical Library, New York, 1955. 88 pp. \$2.50.
- Beyond Our Limitations.** Tracy Hollingsworth Lay. Philosophical Library, New York, 1955. 114 pp. \$3.
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Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to *Science*, but to the publisher or agency sponsoring the publication.)

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Technical Papers

Nomenclature and Structure of 1,2,3,4,5,6-Hexachlorocyclohexanes

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A considerable literature has grown up concerning the geometrical structure of the various 1,2,3,4,5,6-hexachlorocyclohexane isomers. The gamma isomer is one of our most potent insecticides. The isomers have been pictured either as planar or nonplanar, and various methods of naming them have been used. It is the purpose of this note to indicate the accepted structures of the isomers using the planar and nonplanar configuration and to suggest that the nomenclature be standardized as shown.

Eight different forms of the 1,2,3,4,5,6-hexachlorocyclohexanes are possible if we assume a planar carbon ring or a nonplanar carbon ring the two configurations of which are interconvertible. One of these forms may exist as an optically active material. Five of the hexachlorocyclohexanes have been isolated from samples of benzene hexachloride obtained by the direct photochlorination of benzene. Recently Kolka *et al.* (1) prepared a sixth, designated as the *eta* isomer, by the photochlorination of individual benzene tetrachloride isomers. Evidence has also been offered by

these workers that a seventh, designated as the *theta* isomer, can be formed in a similar fashion. The *alpha* isomer is a racemic mixture; the levorotatory form has been isolated by Cristol (2).

In Fig. 1 the cyclohexane ring is represented as being planar, with the chlorine substituents perpendicular to and either above or below the plane of the ring. All the possible isomers are indicated, and because it has been postulated at various times that the insecticidal property of the gamma isomer may be due to interference with the normal metabolism of the inositol, the structures of the known inositols are also given.

The nomenclature used is based on a modified Maquenne (3) numbering system, as suggested by Fletcher *et al.* (4). The configurations are given by a fraction. A particular carbon atom is placed in the numerator or denominator according to whether the substituted group is above or below the plane of the ring. Numbering is clockwise.

The last two configurations in Fig. 1 are optically active modifications of the same form. We have two different numbers for equivalent positions of the optically active compound. However, if we number the structure IX counterclockwise, we can assign the same number to both forms.

Although it is often convenient to use the planar representation, it has been shown by electron-diffraction measurements (5) and other physical and chem-

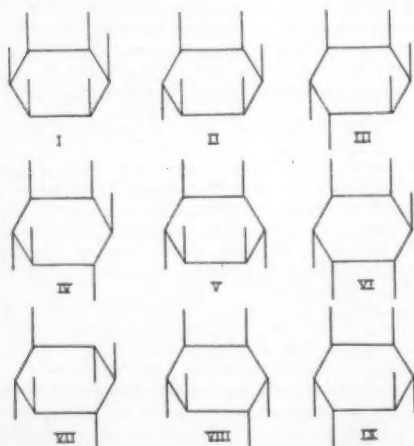


Fig. 1. Hexachlorocyclohexanes (benzene hexachlorides) and hexahydrocyclohexanes (inositols). For each structure the configuration is given followed by the name of the hexachlorocyclohexane isomer, a dash, and the name of the corresponding inositol. (I) 123456/0 unknown-unknown; (II) 12345/6 theta-epi; (III) 1234/56 eta-allo; (IV) 1235/46 delta-myo (meso); (V) 1245/36 gamma-muco; (VI) 123/456 epsilon-unknown; (VII) 135/246 beta-scylitol; and (VIII) 125/346 and (IX) 124/356 alpha (a racemic mixture; the levorotatory form has been isolated)-dl inositol.

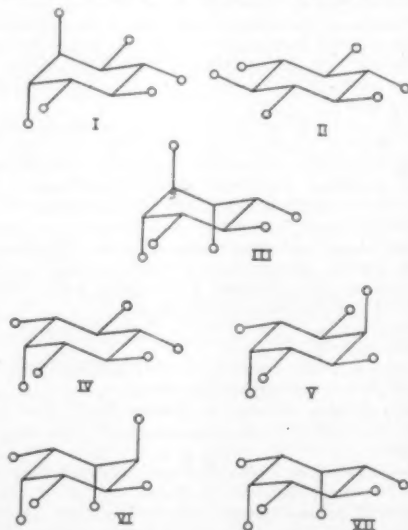


Fig. 2. Isomers of hexachlorocyclohexanes. If the carbons with the substituents parallel to the axis of symmetry are designated *a* and the ones with the equatorial substitution are designated *e*, the configuration can be represented as follows: (I) alpha, *aaeeee*; (II) beta, *eeeeee*; (III) gamma, *aaeeee*; (IV) delta, *aaeeee*; (V) epsilon, *aaeeee*; (VI) eta, *aaeeee*; and (VII) theta, *aaeeee*.

ical methods that the cyclohexane ring in the hexachlorocyclohexanes can best be represented as a modified chair form.

There is an alternating axis of symmetry in the structure, and the bond between any carbon atom and its constituent may be parallel to this axis or in an equatorial position somewhat above or below the perpendicular to the axis. The configurations assigned to the different isomers on this basis are shown in Fig. 2. Various designations, such as polar, equatorial, epsilon, and gamma, have been given to these bonds. It is suggested that the positions be named according to a recent proposal by Barton *et al.* (6). The term axial is used for substituents parallel to the axis of symmetry and is symbolized *a*; equatorial substituents are symbolized *e*.

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2 November 1954.

Partial Charges on Atoms in Organic Compounds

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The recent development of a simplified theory and method of estimating quantitatively the contribution to charge distribution made by atomic electronegativities (1-3) should be of especial interest in organic chemistry. This paper outlines the fundamental ideas and methods of calculation, presents numerical data for facilitating application, and discusses the interpretation of chemical phenomena.

The chief quantitative indication of molecular charge distribution hitherto available has been the experimentally determinable electric dipole moment. This value indicates only the over-all charge distribution, with no evidence of the relative importance, or even of the existence, of the several factors involved (4). In addition to the atomic charges and bond polarity introduced by the initial differences in atomic electronegativity, there are also possible effects arising from differences in atomic radius, from hybridization unsymmetric with respect to the nucleus, from polarization of nonbonding electron pairs, from the interaction of separate bonds to the same atoms, from electrostatic interaction between atoms not directly joined, and from the mobility of electrons of multiple bonds.

The reason for listing these factors now is to emphasize at once the complexity of charge distribution and the folly of expecting too much from the evaluation of the dipole moment or of any of its contribut-

ing factors, such as bond polarities and atomic charges. Nevertheless, such data are useful where they are helpful in interpreting chemical phenomena.

The method of estimating the charge distribution that would result from the effect of initial electronegativity differences on bond polarity is speculative. However, it introduces some ideas whose demonstrated utility in inorganic applications (3) justifies careful consideration in organic chemistry.

One of the most important of these ideas is the principle of electronegativity equalization: *When two or more atoms initially different in electronegativity combine chemically, their electronegativities become equalized in the molecule.* The intermediate electronegativity of the molecule is taken as the geometric mean of the electronegativities of all the atoms before combination. The equalization of electronegativities occurs through the adjustment of the polarity of the bonds, which is pictured as resulting in a partial charge on each atom. That is, electron loss causes increase and electron gain causes decrease in electronegativity. If it is assumed (2) that the electronegativity of an atom changes linearly with charge, and that, as an arbitrary standard, the bond in an isolated molecule of NaF is 75-percent ionic, it is possible to determine that change in the electronegativity of an atom that would correspond to the complete gain or loss of one electron. The partial charge on an atom in a molecule is then estimated as the ratio of the change in electronegativity that is undergone when the free atom joined the molecule to the change that the atom would have undergone in acquiring unit electronic charge.

Data for calculating approximate partial charges on atoms in organic molecules are given in Tables 1 and 2. Table 1 lists the electronegativities [expressed as stability ratio (SR) values (1)] of some elements commonly occurring in organic compounds, together with logarithms of the electronegativities (for use in calculating geometric mean values for molecules), and the changes in electronegativity corresponding to the acquisition of unit charge. Table 2 simplifies the calculation of molecular values by listing the log SR sums for a number of common organic radicals and functional groups.

Table 1. Electronegativities of some elements and data for estimating the charge on combined atoms; $\delta_R = (SR_{\text{compound}} - SR_R) / \Delta SR_R \rightarrow E^+$.

Element (E)	SR _R	Log SR _R	ΔSR $R \rightarrow E^+$
C	3.790	0.5786	4.050
H	3.550	.5502	3.919
O	5.210	.7168	4.749
N	4.490	.6522	4.408
F	5.750	.7597	4.988
Cl	4.930	.6928	4.618
Br	4.530	.6561	4.426
I	3.840	.5843	4.077
P	3.340	.5237	3.802
S	4.110	.6138	4.216
Si	2.620	.4183	3.418

Table 2. Log *SR* sums for organic radicals and functional groups.

Group	No. of atoms	$\Sigma \log SR$	Group	No. of atoms	$\Sigma \log SR$
CH	2	1.1288	CHO	3	1.8456
CH ₂	3	1.6790	COOH	4	2.5624
CH ₃	4	2.2292	COO	3	2.0122
C ₂ H ₅	7	3.9082	CO	2	1.2954
C ₃ H ₇	10	5.5872	CONH ₂	5	3.0480
C ₄ H ₉	13	7.2662	COCl	3	1.9882
C ₆ H ₁₃	16	8.9452	NH ₂	3	1.7526
C ₆ H ₁₅	19	10.6242	NH	2	1.2024
C ₈ H ₁₇	11	6.2226	NO	2	1.3690
C ₈ H ₁₉	10	5.6724	NO ₂	3	2.0858
C ₈ H ₁₉	9	5.1222	CF ₃	4	2.8577
CH ₂ C ₆ H ₄	14	7.9016	CF ₂	3	2.0980
C ₆ H ₄ CH ₃			CF	2	1.3383
OH	2	1.2670	SH	2	1.1640
CN	2	1.2308	SO ₂ H	5	3.3144

Some suggestions are offered here as an aid to the successful application of atomic-charge data.

1) The existence of partial charges on the atoms of a molecule implies not only polarity of the bonds but also special susceptibility of the charged atoms to the electrostatic interactions with other and separate charged atoms of the same molecule, if geometry permits. The molecular geometry may therefore be an important cofactor in the behavior of the molecule.

2) Steric influences apart from the electrostatic influences just referred to may also affect the molecule's behavior.

3) Much of organic chemistry involves multiple bonds in which certain electrons are more than ordinarily mobile. Such electrons may be especially susceptible to electrostatic influences introduced by bond polarity and may tend to oppose its expected effect. Mobility of outer unshared electron pairs may also be significant.

4) The availability on an atom of electrons for chemical reaction will, in general, be expected to diminish with increasing positive charge and to increase with increasing negative charge.

5) In evaluating the electron-releasing or electron-withdrawing power of an atom or group, it is necessary to take into account not only the charges on the atoms most directly involved but also the charge capacity of these atoms as influenced by the attached atoms or groups of atoms. The latter may be regarded as reservoirs that may permit an atom to release considerable charge without becoming excessively positive or to withdraw considerable charge without becoming excessively negative.

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22 October 1954.

New Blocking Agent against the Development of LSD-25 Psychosis

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Our clinical observations on Meratran (1), alpha-(2-piperidyl) benzhydrol hydrochloride, followed the experimental work of Brown and Werner (2). It differs significantly from other central nervous system stimulants such as the amphetamines. No cardiovascular pressor reactions, no appetite loss, and little disturbance in nocturnal sleep have been observed with this compound, which may be used therapeutically in mild depressive states (3) as well as in narcolepsy and certain selected motor tic syndromes (4). Himwich and his associates (5) state that Meratran is not a sympathomimetic drug. They have demonstrated that the central reticular substance of the rabbit brain is stimulated by the compound, followed by cortical stimulation, and Heath (6) found that Meratran has a unique ability to cause rapid high-voltage activity in the septal area of the monkey electrographically.

These clinical and experimental results impressed us with the fact that other compounds of similar chemical configuration might also be of value as therapeutic agents in disorders of the central nervous system. Brown and Werner (7) have found that the gamma-isomer of Meratran, alpha-(4-piperidyl) benzhydrol hydrochloride, prevents or diminishes central stimulation induced in the mouse by various agents, including amphetamine, morphine, cocaine, and Meratran.

In June 1954, we began to study this gamma-isomer of Meratran clinically; thus far we find that it appears to have therapeutic value in certain dissociation syndromes, although inconsistently in the dosage range used. Some cases of acute schizophrenia, alcoholic hallucinosis, senile and arteriosclerotic hallucinosis, and, to a lesser extent, some of the more chronic schizophrenic syndromes respond to the oral administration of this drug to a degree that has encouraged us to continue our observations, which will be reported later. Because of the dramatic way in which it has cleared up hallucinated, deluded, and dissociated patients on occasion, and despite the fact that its action has not been consistent, we decided to study the possible effect of this gamma-isomer of Meratran as a blocking agent against model psychoses produced by lysergic acid diethylamide (LSD-25) ingestion (8). Preliminary results are reported here (9).

In the first experiment (10) two healthy male graduate students in psychology swallowed 100 μ g of LSD-25 in 100 ml of distilled water on the morning of 6 Nov. 1954. Typical psychotic responses occurred. In the first student, age 25, weight 88 kg, a 5½-hr psychosis resulted. He wrote:

The pervading feeling was that there was a gulf between me and the rest of the environment. It seemed that it would be impossible for me to communicate

with those across this gulf because I could not establish any common points of reference. Also within this state there were hallucinations and a sense of timelessness, all unusual, none of which had any real emotional tone to them.

In the second student age 22, weight 70 kg, a distressing agitated paranoid state and almost catatonic withdrawal took more than 13 hr to come to an end. His written account reads in part:

I had very little by way of visual hallucinations, but what I consider the important thing that—well, what's a word to describe it—dissociated, plagued, pounded, weighed—all these are inadequate to describe the horrible state I was in, all of them put together. Perhaps the central thing was suspicion and fear that you would find out about me, or perhaps think things that were not true. On and on and ON this went, and, as was no doubt obvious, I decided to do as little as possible so I wouldn't make any mistakes.

On the next day both subjects were started on the blocking agent orally. The first was given 10 mg twice daily in tablet form; the second was given 5 mg in the same manner. This dose was continued throughout the subsequent week, during which time they continued their usual academic schedules, and a final dose of 10 mg in the first case and 5 mg in the second case was given on arising on 13 Nov. 1954, the date of the second 100- μ g LSD-25 ingestion. The first subject recorded his impressions as follows:

The effects were markedly different on the second Saturday. There was some slight defect of attention and I didn't feel sharp mentally, but I have experienced this same sort of feeling when a hard day's work has tired me out. I felt that I had the situation under control and that I was not dissociated at any time. There were no hallucinations. I felt that I could have gone through my normal routine that Saturday morning although I would have preferred that my work be of a passive sort.

The second subject wrote of his experience as follows:

It was quite similar, yet it was very different. Where the first time, my mind began racing and becoming tangled, eventually swallowing me up despite my efforts, the second time my efforts to fight it off were successful. In one sentence, I think it might be summed up rather adequately by saying: It was a fight both times, but the second time, I won.

The gamma-isomer of Meratran, when given orally as a premedication, did not block the visceral effects of LSD-25 as it did the psychic. Nausea, a vague feeling of numbness in the limbs, tightening of the jaws, dry mouth, conjunctival injection and sweating of the extremities were among the manifestations noted on both occasions. No significant changes in pulse, blood pressure, respiration, or pupillary size were seen on the two experimental days. A month later the first experiment using LSD-25 without premedication was repeated, and psychotic reactions of the original type recurred in both boys, but in the

second case it was terminated abruptly by intravenous administration of the blocking agent.

A second type of experiment was carried out on six subjects, three female and three male. In this study the subjects were kept in doubt about the dose of blocking agent used, or whether the tablets were placebos. None of the subjects reported any subjective or objective reactions during the premedication period. On the experimental day all were given 100 μ g of LSD-25 in distilled water (which is tasteless) but were not informed of the contents of the drink.

Briefly, five of the six developed no psychotic states, or only fragmentary and fleeting manifestations of them, such as attention defect (3 cases), excessive laughter (2 cases), depression of mood level (1 case), fleeting visual hallucinations and distortion of spatial relationships (1 case), and disturbing nausea (3 cases). Dosage of the blocking agent varied from 10 to 30 mg daily for a week in divided doses prior to the LSD-25 ingestion.

The sixth subject, a quiet, intelligent intern, who had received five 1-mg tablets of the blocking agent twice daily for a week prior to ingesting LSD-25, became loquacious and depersonalized in a rapturous experience of "pure unblemished happiness" in which he had visual hallucinations of amorphous swirls of color, and again of green forests, and "an almost unspoken voice arising in response to the overwhelming abundance of sensation." Because he developed this response despite the administration of 10 mg of the blocking agent daily for a week prior to swallowing LSD-25, he was asked to continue the same number of tablets and to return the following Saturday. During the interval he was given five 5-mg tablets of the gamma-isomer of Meratran twice daily instead of five 1-mg tablets of similar appearance and was not told the difference. LSD-25 was given in the same 100- μ g dose after this week of premedication with 50 mg daily of the blocking agent. On the second occasion he read a book and had nothing of the poetic flight of thinking with depersonalization and dissociation, or of the hallucinatory experiences of the previous Saturday, and stated that he could have carried out his intern's duties with his usual level of efficiency.

A recent observation on two subjects in which mesaline sulfate rather than LSD-25 was used suggests that this type of model psychosis can be blocked in the same fashion.

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8 December 1954.

Role of Cytochrome and Pyridine Nucleotide in Algal Photosynthesis

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All known important biological oxidation-reduction catalysts, such as cytochromes, flavins, and pyridine nucleotides, show appreciable changes in the near-ultraviolet or visible region of the absorption spectrum when they undergo oxidation or reduction. If any of these catalysts take part in photosynthesis, one would expect their oxidation-reduction state to change upon illumination.

To study the changes in absorption spectrum that may occur in photosynthesizing cells, a sensitive absorption spectrophotometer was developed with which, for the first time, fast, reversible changes in absorption spectrum were observed in purple bacteria (1-3) and in *Chlorella* (4). In general the changes upon illumination and upon darkening happened within a few seconds. In purple bacteria the difference spectrum in the visible region, obtained by subtracting the absorption spectrum in the light from that in the dark, was similar to, but not identical with, the spectrum obtained by subtracting the absorption spectrum of oxidized from that of reduced cytochrome *c* (3).

These experiments showed that a cytochrome pigment was quickly oxidized in the light and reduced in the dark. In *Chlorella* a peak of the difference spectrum was found at 420 m μ (4). In analogy with our findings with purple bacteria, this peak was tentatively attributed to the oxidation in light of cytochrome *f*, a cytochrome pigment discovered by Hill and Searisbrick (5), and only found in leaves and algae. However, there was also a much higher peak at 520 m μ and a smaller one at 480 m μ . Since neither of these peaks could be attributed to a cytochrome, the interpretation of the effect as a whole was uncertain. Lundegårdh (6), by using a modification of a flow method used by us before (2), measured a narrow region of the difference spectrum of *Chlorella* from 550 to 570 m μ and found, at 555 m μ , a small dip in the difference spectrum, which too, could be attributed to cytochrome *f* (and so interpreted by him).

The experiments described in this article (7) were performed with an apparatus similar in principle to but having a greater sensitivity and range than the original one (1).

Clear-cut evidence for the oxidation of a cyto-

chrome in algae was obtained in experiments on the red alga *Porphyridium cruentum*. The difference spectrum is shown in Fig. 1. The spectrum shows a maximum at 555 m μ which occurs also in the difference spectrum of cytochrome *f*, shown in the same figure, and maximums in the blue resembling those of cytochrome *f*. This shows that in *Porphyridium* cytochrome *f*, or a cytochrome with similar absorption spectrum, becomes oxidized in the light and reduced in the dark. The spectrum of *Porphyridium* was measured after the cells had been in a closed vessel in the dark for about half a day, a treatment that was found to increase the change in absorption upon illumination without profoundly changing the shape of the spectrum in the visible region.

In contradistinction to the spectrum of *Chlorella*, the difference spectrum of *Porphyridium* did not show pronounced peaks at 480 and 520 m μ . The difference spectrum of *Chlorella* showed a peak at 420 and a small dip at 555 m μ , both of which were very probably caused by the same cytochrome pigment as the peaks at 420 and 555 m μ in *Porphyridium*. The magnitude and the time course of the absorption changes in the maximums at 420 and 520 m μ were influenced differently by changing the medium, indicating that these maximums resulted from two different substances.

The oxidation of a cytochrome in light and its reduction in dark in photosynthesizing species of widely different groups suggest an important role for this pigment in photosynthesis. In respiration, the reactions leading to the oxidation of DPNH (reduced diphosphopyridine nucleotide) are mediated by cytochrome *c*. In these reactions, ATP (adenosine triphosphate) is probably generated (9), and the function of the cytochrome in photosynthesis may well be that of an intermediate in processes leading to the formation of ATP, which presumably is needed to assist in the carbon dioxide reduction (10). Arnon *et al.* (11) showed that ATP can be generated by illuminated chloroplasts from added ADP (adenosine diphosphate) and inorganic phosphate.

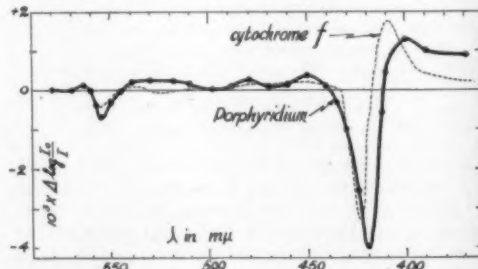


Fig. 1. Difference spectrum of *Porphyridium*, absorption spectrum in light minus that in darkness; and of cytochrome *f*, oxidized minus reduced. The latter spectrum was obtained by subtracting the spectra of reduced and oxidized cytochrome *f* measured by Davenport and Hill (8). The optical density of the *Porphyridium* suspension corrected for scattering was 0.46 at 680 m μ .

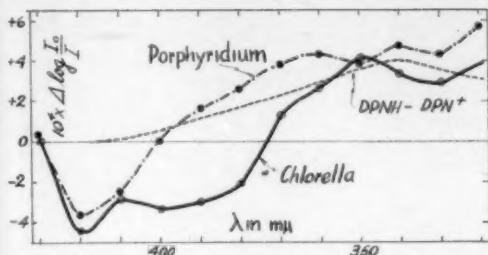


Fig. 2. Difference spectra of *Porphyridium* and *Chlorella*, light minus darkness, and difference spectrum of DPN. The optical density of the *Porphyridium* suspension corrected for scattering was 0.47 at 630 mμ, that of *Chlorella* 0.60 at 680 mμ.

The difference spectrum of *Chlorella* as well as that of *Porphyridium*, were measured for suspensions freshly prepared from growing cultures. Both spectra show an increase in absorption around 350 mμ (Fig. 2). The absorption of pyridine nucleotide increases upon reduction in the same region. Unfortunately the difference spectrum does not have several sharp peaks like the difference spectrum of the cytochrome pigments. Thus we can say only that the difference spectra of the algae in the ultraviolet support the working hypothesis that upon illumination of photosynthesizing cells a pyridine nucleotide becomes reduced to be reoxidized within a few seconds in the dark.

The broadening of the peak at 420 mμ in the *Porphyridium* spectrum of Fig. 2, as compared with the corresponding peak in the spectrum of Fig. 1, may be caused by the different growth conditions or subsequent treatment of the culture. The decrease in absorption in the *Chlorella* spectrum around 390 mμ may be the result of the activity of the pigment or pigments that are responsible for the maximums at 480 and 520 mμ.

The optical density of the *Chlorella* suspension at 680 mμ corrected for scattering was 0.60. The measured optical density of chlorophyll and the change in optical density of pyridine nucleotide indicate that one molecule of nucleotide is reduced in light per about 100 chlorophyll molecules. When DPN⁺ (diphosphopyridine nucleotide) was added to a final concentration of $10^{-4}M$ to a chloroplast suspension, in our apparatus a partial reduction of added DPN⁺ could be observed. The ratio of reduced to oxidized form was about 1/2000. This explains why the reduction of DPN⁺ by illuminated chloroplasts could not be detected before by conventional spectroscopy. This experiment shows, in a direct way, that DPN⁺ can be reduced by illuminated chloroplasts, and confirms a conclusion previously reached in an indirect way (12).

The results of these experiments, combined with those of others, make plausible the following hypothesis, which can be tested by further experiments. Chlorophyll *a*, directly or indirectly excited by light,

reacts with an oxidized pyridine nucleotide, PN⁺, and an unknown oxidant, ZH, to give reduced pyridine nucleotide, PNH, and Z a strongly oxidizing compound. This reaction is followed by various dark reactions. Z is used for the greater part to oxidize water. Part of the Z oxidizes a cytochrome, presumably cytochrome *f*. The PNH also participates in two reactions. The main part is used for reduction of CO₂; a smaller part of the PNH is used for the reduction of the cytochrome (via intermediate enzymes). The oxidation of PNH by Z, mediated by the cytochrome, generates ATP to assist in the reduction of CO₂.

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7 September 1954.

Carbon Dioxide Fixation by Roots

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In the course of recent work we have had occasion to analyze the pattern of carbon dioxide fixation by roots, primarily the onion and soybean (1). Although this subject has been investigated (2) with barley roots, some differences in the distribution of radioactivity make it appear worth while to report our results.

Six to eight excised roots approximately 1 cm long were sealed in a vial containing 1 ml of distilled water and NaH¹⁴C₃O₃ (0.125M). In a control experiment to test the possible effects of excision, onion roots about 10 cm long were passed through a glass tube bent at a 90° angle. The bend was sealed with mercury, permitting exposure of the roots alone to radiocarbon dioxide without removal of the roots from the bulb. The pattern of fixation of excised and attached roots proved to be identical. After 1 hr of exposure to the radioactive solution, the roots were dropped into boil-

ing 80-percent ethanol within the outer member of a homogenizer, ground with the inner member, and refluxed gently for 10 min. In some cases the roots were frozen and ground in liquid nitrogen prior to extraction, resulting in identical chromatograms. Following concentration in small glass cones, the extracts were transferred to Whatman No. 1 sheets for chromatography. Two-dimensional, ascending chromatograms were made, first using 80-percent phenol and then butyric acid, butanol, and water (2:2:1) as solvents.

In general, the complete coincidence of a spot eluted from the radioactive chromatogram upon two-dimensional chromatography with the pure compound was considered sufficient identification (3). However, additional proof was obtained for glyoxylic and glycolic acid by derivation. Carrier glyoxylate was added to the radioactive compound and the phenylhydrazone was prepared. The specific activities remained unchanged through three recrystallizations. Similarly, the specific activity of the *p*-nitrobenzoate of glycolic acid remained unchanged.

A typical radiogram is shown in Fig. 1. As with barley, by far the most prominent spot was malic acid. Activity was also found in alanine, glutamine, glutamic, aspartic, citric, succinic, isocitric, glyoxylic, and glycolic acids. The presence of the last two compounds is somewhat unusual and generally not included in fixation or exchange reactions accompanying the tricarboxylic acid cycle. In contrast with Poel's results, no spot corresponding to tyrosine was found in any experiments with the onion or soybean, or in a single experiment with barley. There seems, indeed, to be no valid reason, at our present state of knowledge, to expect this compound to possess any appreciable activity. As was reported previously (1), the pattern of fixation was not altered by a number of drugs, even when respiration was strongly inhibited. Glyoxylic acid has been found in cell-free bacterial preparations (4), and a major role in metabolism has been postulated for this compound. The possibility that glycolic and glyoxylic acids are deg-

radation products of our extraction and/or chromatographic techniques cannot be ignored, but they would have to result from compounds other than those found on our chromatograms.

Poel's finding of the diminution of radioactivity in nutrient solution, as compared with distilled and tap water, is difficult to interpret. We have found that, on immersing soybean roots in increasing concentrations of KCl (0, $2.00 \times 10^{-4}M$, $2.00 \times 10^{-3}M$, and $2.00 \times 10^{-2}M$), there was an increase in radioactivity (1730, 2050, 3010, and 4610, respectively) (5). The stimulation of root respiration by increasing salt concentration is a well-known phenomenon. This increased rate of production of (nonradioactive) carbon dioxide is, of course, accompanied by an increased rate of production of organic acids partly capable of exchange and fixation. These effects will oppose each other in terms of the final radioactivity found—that is, whether increased respiration results in increased radioactivity will depend in large measure on the rate of enzymatic exchange and fixation as compared with the dilution of the specific activity of external carbon dioxide by the additional carbon dioxide produced within the roots. If the latter far exceeds the former, then it is conceivable that increased respiration will result in diminished activity. Other factors, however, such as the absolute increase in external carbon dioxide tension (which is reflected, then, in the ratio of root to solution volume), will have to be considered.

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22 October 1954.

Rapid Method for Determining Mean Values and Areas Graphically

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The observed data in many fields of scientific investigation are recorded on continuous graph paper, charted either manually or by various motor-driven devices. It is frequently necessary to determine the mean value of the recorded quantity from such a chart, or to estimate areas bounded by such graphs. A simple method (1) was devised for accomplishing either of these ends. This method requires only a pencil and ruler (or straightedge) and can be completed by means of a single broken line without lifting the pencil from the paper. The technique was originally

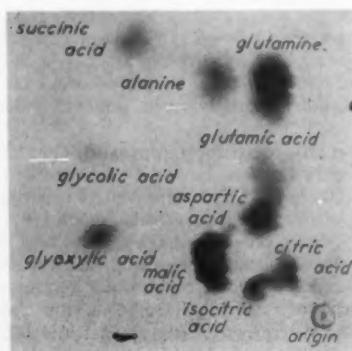


Fig. 1. A typical radiogram.

developed for the analysis of lengthy temperature records, and has since been applied to electroradiograms, ballistocardiograms, electrophoresis patterns, tonograms, and a variety of data recorded at timed intervals. One of the chief advantages of this method is that mean values can be obtained directly on the original graph, without transcribing the numerical values or performing any arithmetical calculations.

Method. As an example, let us take eight values recorded on ordinary rectangular graph paper at points $A, B, C \dots H$ (Fig. 1). The technique will be seen to be the same no matter how small or how large the number of points. It is assumed that the horizontal spacing or "timing" between the points is uniform.

Place a ruler so that it passes through points A and B . Start with the pencil at A and draw Ab , stopping on the vertical line midway between A and B . Next, with the pencil held at b , turn the ruler so that it passes through b and C . Draw bc along bC , stopping on the vertical line through B . Next, with the pencil held at c , turn the ruler so that it joins c and D , and draw cd as shown. Continue in this manner, each time directing the straightedge toward the next in the series of points and advancing the pencil to the right by half the space between the vertical lines through the original points, until arriving at the final point H . The height of h above the horizontal axis, measured according to the vertical scale used for the graph, provides the desired mean value.

Although the simplicity of this method renders it relatively free from error, a brief check is readily available and should be performed. Start at H , and along HG draw Hg' (Fig. 1), then $g'f'$, and so on until a' is reached. The point a' will coincide with a if no errors have been made.

Proof. By employing a few properties of centroids (centers of gravity), a nonalgebraic proof can be provided. Assume that a mass of 1 unit is placed at each of the points $A, B, C \dots H$. Then the centroid of all of these points will have a height above the horizontal axis equal to the arithmetic mean value of the height of the individual points. In arriving at the centroid

geometrically, points A and B with mass 1 unit each may be replaced by a mass of 2 units placed at b . This may be represented by the symbol b_2 . The centroid of b_2 and C_1 is situated at c , along the segment bC , dividing the length bC in proportion to the masses, and nearer to the "heavier" point. Similarly c_2 and D_1 may be replaced by d_2 , and so on until h_2 represents the combined mass at the centroid.

Comments. The procedure described may be applied to a record consisting of any number of discrete points. In the case of a continuous graph, it is necessary to mark off, along the graph, points equally spaced horizontally, and to apply the method to these selected points. The accuracy of the final result will in general increase as the subdivisions are made finer.

In order to estimate areas under curved graphs (that is, the area between a portion of the curve, two vertical lines and the corresponding portion of the horizontal axis), it is necessary merely to multiply mean value, as derived above, by the length of the horizontal extent.

A review of the relevant literature on graphical methods revealed only a single reference (3) to a method at all comparable. However, the present method proved to be considerably easier and more rapid to apply.

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11 August 1954.

Inhibition of Root Growth by Azaserine

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The tumor-inhibitory substance, azaserine, produced by an unidentified *Streptomyces*, has been shown to possess antibiotic activity on a wide range of organisms (1). This substance, identified as *O*-diazonacetyl-L-serine (2), completely inhibited a wide range of organisms at concentrations of 25 to > 100 $\mu\text{g}/\text{ml}$. Some organisms are more sensitive; 50-percent inhibition of several bacilli was obtained at 2 to 4 $\mu\text{g}/\text{ml}$; *Escherichia coli* was inhibited 50 percent by 9.3 $\mu\text{g}/\text{ml}$; two clostridia, *Cl. fesceri* and *Cl. hemolyticum* were completely inhibited at 0.5 $\mu\text{g}/\text{ml}$, and *Cl. perfringens* and *Cl. septicum* at 2.5 $\mu\text{g}/\text{ml}$ (3).

Several experiments have been carried out with azaserine (4) on plant systems. They demonstrate the high potency of this substance in inhibiting root growth (5). One criterion was the effect on the elongation of the primary roots of germinating cucumber seed, var. Early Fortune, at 25°C for 96 hr (6). At $2 \times 10^{-4}M$ and $5 \times 10^{-4}M$ root development was com-

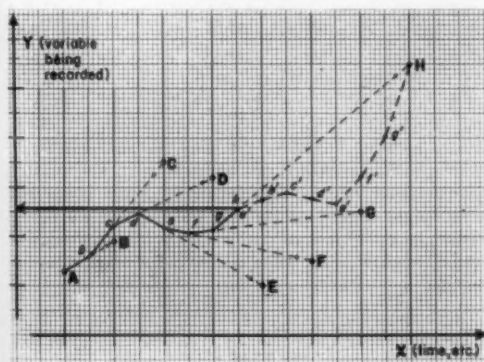


Fig. 1. Graphical determination of mean values.

pletely suppressed. These seeds, if thoroughly washed with water and transferred to distilled water for an additional 4 days, failed to develop roots. At lower concentrations partial inhibition of root elongation occurred (Table 1). It was established from this and another experiment that $1.5 \times 10^{-5} M$ (2.6 $\mu g/ml$) would result in 50-percent inhibition of elongation. In similar but less extensive experiments with barley and flax, elongation of the roots of the former was 50 percent inhibited by approximately $2.5 \times 10^{-5} M$ azaserine, and of the latter at the low concentration of approximately $4 \times 10^{-6} M$ (0.7 $\mu g/ml$).

In aerated water culture the growth of barley roots, var. Moore, was repressed by comparable concentrations of azaserine. The criterion in such tests is the dry weight of roots produced in 5 days at 25°C (Table 2). In this system the concentration producing 50-percent inhibition would be $1.3 \times 10^{-5} M$ (2.25 $\mu g/ml$).

Shoot growth is not affected at levels causing substantial repression of root development. Azaserine has been applied in the following ways to 8-day bean seedlings grown in vermiculite: (i) 50 μg in 0.02 ml 50-percent ethanol to the base of the unifoliate leaf;

Table 1. Azaserine repression of root elongation of germinating cucumber seed (96 hr at 25°C).

Concentration (μM)	Inhibition in root length (%)
200	100
100	84.1
40	69.4
10	38.7
3.3	14.2

Table 2. Azaserine repression of root growth of barley seedlings (5 days at 25°C in the dark).

Concentration (μM)	Reduction in root dry weight (%)
30	73.2
10	43.0
3	15.4

(ii) 100 μg in water, similarly; (iii) unifoliate leaf dipped in $1 \times 10^{-5} M$ solution for 48 hr; (iv) same as (iii) using $1 \times 10^{-4} M$; (v) 25 ml $1 \times 10^{-4} M$ solution applied to the surface of the root medium. None of these treatments produced any apparent inhibition or stimulation of growth of the shoot or of any part thereof, nor were there morphologic changes or teleomorphic responses as occur with growth regulators.

These studies indicate that root growth of cucumber, barley, and flax seedlings is repressed at azaserine concentrations substantially lower than those which cause inhibition of many microorganisms, and of the same order as those reported to be inhibitory to the most sensitive microorganisms. The possibility of employing a plant system for azaserine assay is suggested.

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27 October 1954.

Communications

Wastes and Nutrients

In a recent article by Paul B. Sears [*Science* **120**, 959 (1954)] appears the remarkable statement on page 960, line 7, "Nature long ago discarded the nonsense of carrying poisonous wastes and nutrients in the same vessels." To paraphrase Herbert Dingle's recent delightful article [*Science* **120**, 513 (1954)] "This statement sounds like nonsense, because it is nonsense."

The blood supply must not only convey materials destined for the retail consumers but also remove their garbage, for, apart from incidental losses occasioned by the operation of externally secreting glands, there are no other means available. Even the idea that arterial blood is a supply system, and venous blood a garbage-removal system, is entirely incorrect, both factually and philosophically. The urgent necessity of keeping the individual consumer, or tissue cell, in

a reasonably ordered and stable environment—the well-known homeostasis of Cannon—is such that sudden and marked changes of all kinds are undesirable. (This matter might in itself appear to warrant serious ecological investigation.) In reality it is found that the system of supply, as well as the system of garbage removal, work on percentage rather than on absolute changes, and in this way the shocks of both deliveries and pick-ups are minimized. In this matter, the presence of garbage, especially some kinds like urea, plays a very useful role indeed, and we are in consequence led to a second criticism that the common and thoughtless use of such phrases as "poisonous wastes" on occasion may also equally become "nonsense."

O. S. GIBBS

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13 December 1954.

In my paper on "Human ecology" [*Science* 120, 962 (1954)] the reference to "the late Otto Glaser" should read "Otto Glasser." Otto Glaser, professor emeritus of biology at Amherst, died in 1951. I am happy to report that Otto Glasser of the Department of Biophysics, Western Reserve Medical School, and editor of the excellent handbook of *Medical Physics* is still very much alive.

To O. S. Gibbs of Jefferson Medical College I am indebted for a vigorous objection to my somewhat unguarded statement that "Nature long ago discarded the nonsense of carrying poisonous wastes and nutrients in the same vessels." This is of course not literally true, except as mass effects are concerned, and they are what I had in mind. In both "pure" rivers and "pure" arterial blood there are materials with a considerable range of physiological properties, their effects being regulated by what amount to homeostatic processes. These processes break down in streams overcharged with human waste, industrial and domestic, and since we often depend on such streams for public water supply, a situation amounting to biological nonsense does exist.

Perhaps I should have used the analogy of upper and lower alimentary canal rather than artery and vein. But since the bulk of correspondence concerning the article has come from medical men, none of whom have raised the issue, I assume that my intent was clear and the analogy was not wholly inappropriate.

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Conservation Program,
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6 January 1955.

C¹⁴-Labeled Ergot Alkaloids

To provide detectable material for *in vivo* studies with the alkaloids and their derivatives and to enable an extension of our investigations on their biosynthesis, we have produced C¹⁴-labeled ergot alkaloids (1).

Rye was grown in crocks and, prior to flowering, sealed in bell jars of 40-lit capacity. Approximately 160 ml of CO₂, containing 0.1 mc C¹⁴, was introduced each day for 9 days. Illumination at an intensity of 300 ft-cd was continuous for 12 days. The plants, after removal, were infected with a culture of *Claviceps purpurea* and maintained in a normal environment until the sclerotia were mature. Fourteen sclerotia, of total weight 192 mg, were obtained.

The defatted sclerotia were extracted and the alkaloids isolated by a column partition chromatographic procedure (2). Further purification was effected by converting the alkaloid to the lactate and shaking with ether to remove nonalkaloid contaminants. The base, generated in aqueous solution, was recovered by shaking with ether-chloroform (2:1) mixture.

The ether-chloroform solution was evaporated on a planchet, and 20 1-min counts were made with a thin mica end-window G-M tube. The residue was redissolved in ether and again counted. The alkaloid was

Table 1. Results of analysis.

Alkaloid	counts/min		Amt. count/min (μg) mg	
Ergotoxine	144.8 ± 1.9	151.8 ± 3.3	68.5	2115 2216
Ergotamine	334.3 ± 4.5	358.1 ± 3.7	240.4	1390 1489
Ergonovine	42.1 ± 2.0	50.0 ± 1.6	6.0	7016 8333

quantitatively removed, converted to the lactate, and assayed spectrophotometrically using *p*-dimethylaminobenzaldehyde test solution (U.S.P.). The results of analysis are reported in Table 1. Production of a larger quantity of labeled alkaloids is planned.

ARA G. PAUL

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References and Notes

1. Aided by grants from the U.S. Atomic Energy Commission, contract No. AT (30-1) 1666.
2. J. E. Carless, *J. Pharm. Pharmacol.* 5, 883 (1953).

8 December 1954.

Diffusion Constant and Diffusion Coefficient

In his treatise, *The Anatomy and Physiology of Capillaries*, Krogh (1, p. 268) defines the diffusion constant as

... the number of cc of gas which will in one minute diffuse through an area of 1 cm², when the pressure gradient is one atmosphere per μ (0.001 mm).

Krogh uses this definition in his discussion of diffusion within tissues. The term *diffusion constant* has usually been regarded as analogous to the diffusivity (2), but Krogh's diffusion constant differs from the diffusivity, or diffusion coefficient, in two ways: in defining the gradient it employs the micron instead of the centimeter, and it employs "tension" units instead of concentration units. ("Tension" is partial pressure of diffusing substance in the gas phase at equilibrium between gas and liquid phases.) The first difference is unimportant because it simply introduces a constant factor of 10⁴; but the second is important because it makes the diffusion constant a composite of two variables, the diffusivity and the solubility of diffusing substance in the liquid medium. For example, Krogh lists a value of 0.34 for the diffusion constant of O₂ in water at 20° C. The diffusivity of O₂ in water is 1.607 cm²/day (Spoehr, 3), or 1.12 × 10⁻³ cm²/min. The solubility of O₂ in water is 0.031 at 20°C. Thus the magnitude of the diffusion constant of Krogh can be computed as 1.12 × 10⁻³ × 0.031 × 10⁴ = 0.346.

Obviously this diffusion constant is not an index of diffusivity because it is so importantly influenced by solubility; yet it appears that physiologists have made the error of assuming that it is such an index.

Prosser *et al.* (4) reproduce Krogh's definition and

indicate in parentheses that it differs from the diffusion coefficient by a factor of 10^4 ; thus they fail to point out the important distinction between them. And they state,

In spite of its larger molecular size carbon dioxide diffuses through tissues 20 to 30 times faster than oxygen does, owing to the higher solubility of CO_2 .

This sentence leaves the impression that solubility somehow imparts a 20 to 30-fold higher diffusivity to the heavy CO_2 molecule. Actually the diffusivity of CO_2 is $1.378 \text{ cm}^2/\text{day}$ (3), which, compared with 1.607 for O_2 , is inversely proportional to the square root of molecular weight, in agreement with Graham's Law. Krogh himself implies that the diffusivity of CO_2 is many times higher than that of O_2 , for he states (1, p. 273),

... the carbon dioxide produced in the tissues can always be eliminated by diffusion into the capillaries, since the diffusion constant for CO_2 in tissues is some thirty times higher than for oxygen. The CO_2 pressure difference between any point in the tissue and the blood must, moreover, in all circumstances, be an absolutely negligible quantity.

Actually, the concentration gradient required to achieve a given CO_2 transport must be higher than for the same O_2 transport; therefore Krogh's use of the words *absolutely negligible* indicates that he failed to distinguish between his diffusion constant and the diffusion coefficient. Furthermore, both Prosser *et al.* and Krogh state that the diffusion constant for oxygen increases about 1 percent/deg C, taking the 20°C rate as unity. This statement is false. It is approximately true for the diffusion coefficient [the temperature coefficient of O_2 diffusivity in water, as is indicated by the dropping Hg electrode, is 1.6 percent/deg C in the neighborhood of 20°C (5)], but the influence of solubility, which decreases with rising temperature, will offset the increase in diffusivity. Thus the magnitude of the diffusion constant for O_2 in water at 30°C is about $1.30 \times 10^{-3} \times 0.026 \times 10^4 = 0.338$, which is almost identical to the value at 20°C .

These quotations and computations show that Krogh's diffusion constant has been erroneously regarded as an index of diffusivity, and that many biologists have been led to believe that CO_2 has a higher diffusivity than O_2 in aquatic mediums. The error has resulted from the unfortunate use of tension units (6) in Krogh's diffusion constant.

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8 December 1954.

Antibiotic Effect on *Ceratomyella fimbriata* of Ipomeamarone, an Abnormal Metabolite in Black Rot of Sweetpotato

It has been reported that the respiratory increase in black-rotten sweetpotato roots infected by *Ceratomyella fimbriata* is caused by the uncoupling action of ipomeamarone (Ip.) (1-3)



that had been accumulated in the infected parts by the sweetpotato. It is important, we suppose, from the phytopathological point of view, to learn whether Ip. disrupts the phosphorus metabolism of the penetrating fungus or not, and to make clear the relationship between the accumulated Ip. and the resisting power of the sweetpotato root. M. Hiura has proved that the germination of *C. fimbriata* is controlled in the Ip.-containing culture medium, and we confirmed that the growth, sporulation, spore formation, and respiration of the fungus were restrained by Ip.

In our experiments with the spore-cell suspension taken from the shaking culture, as well as with the mycelium prepared from surface culture, we observed that Ip., even in a low concentration, prevented the absorption of inorganic phosphate by *C. fimbriata* from the medium and the conversion from inorganic P to acid-soluble-organic P and insoluble P. At the same time Ip. promoted spore respiration in the same concentration. The fact became more evident in an experiment using a medium containing P^{32} in which Ip. prevented the conversion of inorganic P^{32} into acid-soluble P and insoluble P.

S. Spiegelman *et al.* (4) proposed from their data on phosphate metabolism of yeast that ATP, generated through glycolysis or respiration, was required when inorganic P in medium was converted into acid-soluble-organic P and insoluble P; thus uncouplers such as DNP, azide repressed considerably the conversion of inorganic P.

The mechanism of antibiotics such as Aureomycin, usnic acid, gramicidin, and dehydroacetic acid (5), and others has been known to be based on the uncoupling action of oxidative phosphorylation. Now we suppose that Ip. also takes part in the resistive power of sweetpotato root against *C. fimbriata* as an uncoupler.

In addition, oxidative product of chlorogenic acid was observed to repress the oxidative phosphorylation of sweetpotato particles. The oxidative product of chlorogenic acid by polyphenol oxidase in the infected tissues also might be explained to be a factor contributing to the resistance of sweetpotato root.

A further investigation of ours has been focused upon the relationship of Ip. to the nucleic acid metabolism of *C. fimbriata*, the mutation, and adaptation of the fungus.

We are grateful to Yusuke Sumiki, Saburo Funahashi, and Takashi Kubota for their advice.

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References and Notes

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12 July 1954.

Chemopallidectomy: An Investigative Technique in Geriatric Parkinsonians

In March 1954 I described a simple technique of intracerebral procaine injection in the region of the globus pallidus in hyperkinetic disorders. This technique permits one to place a small caliber cannula or catheter into the brain through a trephine opening without the use of a stereotaxic instrument. Then, by injections of small amounts of procaine, one can locate that intracerebral area, the procainization of which will temporarily relieve parkinsonian tremor and rigidity, in the contralateral extremities, without causing motor weakness. It was suggested at that time that this technique might be used to locate a physiologic landmark, the permanent destruction of which



Fig. 2. Roentgenogram which was made during chemopallidectomy. Note air in the lateral ventricles and third ventricle. A tantalum stylet which lies within the polyethylene catheter denotes the position of this instrument. Compare with Fig. 1. Injection of procaine through the polyethylene catheter in this case alleviated contralateral tremor and rigidity. Subsequent injection of absolute alcohol produced alleviation of tremor and rigidity persisting for several months and up to the time of this report.

would provide longer lasting relief of tremor and rigidity. The purpose of this communication is to report an investigative effort in that direction.

Using essentially the technique described earlier (1), a small polyethylene catheter with a tantalum stylet is introduced into the brain in the region of the globus pallidus (Fig. 1). Roentgenographic confirmation of the position of the catheter is obtained (Fig. 2). Procaine is injected in increments of 0.25 ml or less, at 5-min intervals, with minor corrections of catheter placement when necessary, until contralateral tremor and rigidity have been relieved. This relief of tremor and rigidity indicates that the "physiologic landmark" has been reached. The catheter is secured so that it remains at this depth and roentgenographic documentation is again obtained. One milliliter of absolute alcohol is then introduced into this area in increments of 0.07 ml every 30 sec. The catheter is left in place for 48 or 72 hr so that the neurolytic lesion can be enlarged if tremor or rigidity recur during this time. Roentgenographic verification of the position of the catheter is obtained before reinjection is carried out.

This technique is currently being investigated in patients older than 55 yr who are considered too old for the operation of anterior choroidal artery occlusion (2, 3). No mortality or lasting motor weakness has yet been encountered with this technique. Of five cases followed for 6 mo or longer, two had recurrence of symptoms in less than 3 mo; three subsequent patients have demonstrated relief of tremor or rigidity or both for 6 mo or more following this procedure.

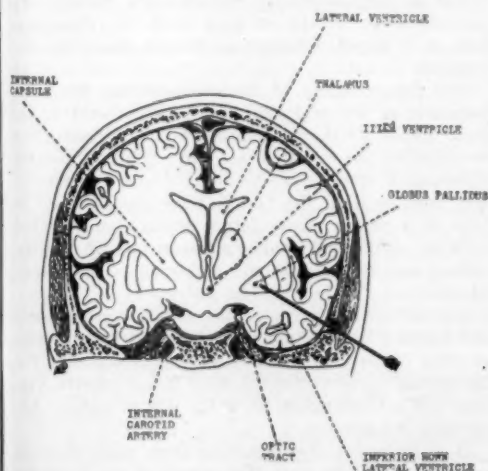


Fig. 1. Cross section of the brain demonstrating the route by which a polyethylene catheter is introduced transcerebrally into the region of the globus pallidus.

On the basis of this preliminary experience it seems to be worth while to bring this investigative technique to attention.

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27 December 1954.

Association Affairs

International Arid Lands Meetings in New Mexico

Gilbert F. White

Haverford College, Haverford, Pennsylvania

Peter C. Duisberg

Desert Products Company and
Allied Laboratories, El Paso, Texas

A major effort to advance international cooperation of scientists from many fields in study of the future of arid lands will be made in New Mexico this spring. The American Association for the Advancement of Science is sponsoring an *International Arid Lands Symposium and Conference* in three parts. The symposium will be held at the University of New Mexico in Albuquerque on 26-29 April, a field trip in the Rio Grande Valley between Albuquerque and El Paso will take place on 30 April and 1 May, and a conference for a smaller group will be held at the New Mexico Institute of Mining and Technology in Socorro on 2-4 May.

The idea for such a gathering came from the Committee on Desert and Arid Zone Research of the Southwestern and Rocky Mountain Division of the association. It was approved last summer by the national AAAS board of directors which then sought support for carrying out the project. Helpful grants toward the cost of the symposium and conference since then have been received from the National Science Foundation and the Rockefeller Foundation. UNESCO has granted funds toward the cost of travel of foreign participants and has convened a meeting of its Advisory Committee on Arid Zone Research in the same region at that time so that members of the committee may take part.

Discussions planned for the symposium and conference will build upon several international arid zone gatherings of the past 5 years. A broad view of desert problems was developed at the Israel conference in 1952 [*Desert Research*, Research Council of Israel Special Publication No. 2 (1953)]. Hydrologic questions received primary attention at the Ankara symposium [*Proceedings of the Ankara Symposium on Arid Zone Hydrology*, UNESCO (1953)]. Biologic aspects of deserts, both hot and cold, were considered

at London [*Proceedings of the Symposium on the Biology and Productivity of Hot and Cold Deserts*, Institute of Biology (1954)]. Plant ecology was the central interest of the Montpellier Symposium in 1953 [report now in press]. Solar energy and wind power were the major topics in the symposium held at New Delhi last autumn [F. Daniels, *Science* **121**, 121 (28 Jan. 1955)].

The New Mexico meetings will differ from the previous ones in several important ways. They will concentrate attention on the frontiers of knowledge over a wide range of interrelated fields. There will be a small number of papers—all invited—and substantial time for discussion following them. Scientists from different fields will address themselves to the same problem. The final day of the symposium will be devoted to discussion in small groups dealing with problems that cut across several disciplines. Since the conference must be limited in numbers so as to promote fruitful exchange of ideas, participation will be by invitation only. The participants will focus attention on a few lines of investigation that seem, in the light of the symposium, to promise benefits from international or interdisciplinary collaboration. Rather than summarize the results of past work, the discussion will, it is hoped, concentrate on new directions for research.

The future utility of the resource base for large segments of the arid zone around the world is far from secure. If their occupancy is to be maintained or extended, the exchange and application of present information must be accelerated and new understandings must be won. The fact that the meetings will be held in a region whose future seems closely linked with the solution of troublesome questions of salinity, silting, and land use should add weight to this emphasis.

See advertising pages of this issue for registration and housing information. For copies of the program or other information, write American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW., Washington 25, D.C., U.S.A. Cable: Advancesei Washington.

It is estimated that scientists from more than 25 countries will take part. The range of the problems to be considered and of the experience of those invited to give papers is shown in the following preliminary program.

Symposium: What Is the Future of Arid Lands?

26 APRIL

Evening lecture, 8 P.M. (open to the public). *Chairman,* George W. Beadle, department of biology, California Institute of Technology, Pasadena, and president of the AAAS, welcome for the Association; The Honorable John Simms, Governor of New Mexico, welcome for the Southwest; Tom J. Popejoy, president of the University of New Mexico, welcome for the University; Joe Dennis, department of chemistry, Texas Technological College, Lubbock, and president of the Southwestern and Rocky Mountain Division of the AAAS, welcome for the Division. Address by Homer L. Shantz, Santa Barbara, Calif., "History of arid zone development and the problems and potentialities of arid lands."

27 APRIL

Technical session I, Variability and predictability of water supply in arid regions. Questions: How predictable is precipitation in an arid region? Are there distinct drought cycles? What are the prospects for usable ground water occurrence in arid areas? What is the practicability of locating and estimating volume and rate of natural recharge of underground water supplies? Within a given watershed, to what degree can the water sources and water yield be determined? *Chairman,* Reed W. Bailey, director, Intermountain Forest and Range Experiment Station, U.S. Department of Agriculture, Ogden, Utah.

9 A.M. C. W. Thornthwaite, director, Johns Hopkins Laboratory of Climatology, Senbrook, N.J.

9:30 A.M. Jean Tixeront, ingénieur en chef des Travaux Publics, Tunis.

10 A.M. Luna Leopold, Water Resources Division, Geological Survey, U.S. Department of the Interior, Washington, D.C.

10:10 A.M. F. Dixey, director of Colonial Geological Surveys, Imperial Institute, London.

10:20 A.M. C. C. Wallén, assistant director, Swedish Meteorological and Hydrological Institute, Stockholm.

10:40 A.M. John H. Dorroh, Jr., hydrologist, Soil Conservation Service, U.S. Department of Agriculture, Albuquerque.

10:50 A.M. Terah L. Smiley, geochronologist, Laboratory of Tree-Ring Research, University of Arizona, Tucson.

11 A.M. Discussion.

11:45 A.M. Summary by the chairman.

Technical session II, Better Use of Present Resources. Questions: What are the possibilities of increasing and maintaining sustained production from grass and forest lands without accelerating erosion? What are the consequences of utilizing arid lands beyond their capabilities? What constitutes wise allocation of available water supplies among the various needs in arid land drainage areas? How can production be increased from existing water supplies? Can irrigated lands be occupied permanently? *Chairman,* Kanwar Sain, chairman, Central Water and Power Commission, Ministry of Irrigation and Power, New Delhi, India.

2 P.M. R. O. Whyte, agronomist, Agriculture Division, Food and Agriculture Organization of the United Nations, Rome.

2:30 P.M. L. N. McClellan, assistant commissioner and chief engineer, Bureau of Reclamation, U.S. Department of the Interior, Denver, Colo.

3 P.M. Hilgard O'Reilly Sternberg, Centro de Pesquisas de Geografia do Brasil, faculdade nacional de filosofia, Universidade do Brasil, Rio de Janeiro.

3:10 P.M. L. A. Richards, physicist, Salinity Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Riverside, Calif.

3:20 P.M. Cyril Luker, field representative, Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C.

3:40 P.M. Raymond Price, director, Rocky Mountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Fort Collins, Colo.

3:50 P.M. Pedro Armillas, archeologist, Instituto Nacional de Antropología, Mexico City.

4 P.M. Discussion.

4:45 P.M. Summary by the chairman.

Evening lecture, 8 P.M. (open to the public). *Chairman,* Peter C. Duisberg, Southwestern Irrigated Cotton Growers Association and Desert Products Company, and chairman, Committee on Desert and Arid Zone Research of the Southwestern and Rocky Mountain Division, AAAS. Address by Charles E. Kellogg, assistant administrator for soil survey, Soil Conservation Service, U.S. Department of Agriculture, Washington, D.C., "Current status of arid zone research and development."

28 APRIL

Technical session III, Prospects for Additional Water Sources. Questions: How practicable is it to induce precipitation? How practicable is it to demineralize saline water? How practicable is it to reuse waste waters? What are the social and economic implications of these programs? *Chairman,* E. J. Workman, president, New Mexico Institute of Mining and Technology, Socorro.

9 A.M. Edward G. Bowen, chief, Division of Radio-physics, Commonwealth Scientific and Industrial Research Organization, Sydney, Australia.

9:30 A.M. Sheppard T. Powell, consulting engineer, Baltimore, Md.

10 A.M. W. F. J. M. Krul, professor at the University of Delft, and director, Government Institute of Water Supply, The Hague, Netherlands.

10:10 A.M. Vincent J. Schaefer, director of research, The Muntalp Foundation, Schenectady, N.Y.

10:20 A.M. Glenn W. Brier, chief, Meteorological Statistics Section, U.S. Department of Commerce, Washington, D.C.

10:40 A.M. H. E. Hayward, director, Salinity Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Riverside, Calif.

10:50 A.M. Louis Koenig, associate director, Southwest Research Institute, San Antonio, Tex.

11 A.M. Discussion.

11:45 A.M. Summary by the chairman.

Technical session IV, Better Adaptation of Plants and Animals to Arid Conditions. Questions: What screening procedures would lead to the selection of more productive plant and animal species for arid regions? What are the genetic and physiological bases for drought resistance in plants and animals? What are the prospects of increasing drought resistance through genetic research? How can we develop a program of revegetation? What are the economic possibilities in the development and utilization of arid land plants and animals? What are the possibilities of maintaining larger human populations in arid areas? *Chairman,* Olaf S. Aamodt, technical specialist, plant sciences, Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md.

2 P.M. Colonel Omar Drax, Egyptian Army Veterinary Corps, director, Desert Range Development Project, Desert Institute, Heliopolis, Egypt.

2: 30 P.M. R. Merton Love, professor of agronomy, Agricultural Experiment Station, University of California, Davis.

3 P.M. Knut Schmidt-Nielsen, professor of zoology, Duke University, Durham, N.C.

3: 10 P.M. Enrique Beltrán, director, Instituto Mexicano de Recursos Naturales Renovables, Mexico City.

3: 20 P.M. B. P. Uvarov, director, Anti-Locust Research Centre, London.

3: 40 P.M. Michael Evenari, professor of botany and vice president, The Hebrew University, Jerusalem.

3: 50 P.M. L. M. Pultz, principal horticulturist, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Md.

4 P.M. Discussion.

4: 45 P.M. Summary by the chairman.

Evening lecture, 8 P.M. (open to the public). *Chairman,* Gilbert F. White, president, Haverford College, chairman, AAAS Planning Committee for the meetings, and U.S. member, UNESCO Advisory Committee on Arid Zone Research. Address by B. T. Dickson, botanist, retired chief, Division of Plant Industry, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia, "The challenge of arid land research and development for the benefit of mankind."

29 APRIL

Discussion groups.

1) "Possibilities for drought prediction in arid areas," *chairman,* Erik K. Reed, regional chief of interpretation, National Park Service, U.S. Department of the Interior, Santa Fé, N.M.

2) "Possibilities for weather modification and control in arid areas," *chairman,* S. E. Reynolds, Research and Development Division, New Mexico Institute of Mining and Technology, Socorro.

3) "Prospects for improved estimation of underground water resources and recharge rates," *chairman,* R. W. Sundstrom, district engineer, Ground Water Branch, Geological Survey, U.S. Department of the Interior, Austin, Tex.

4) "Irrigation and industrial possibilities of desalination and planned use of saline water," *chairman,* T. F. Buehrer, head, department of agricultural chemistry, College of Agriculture, and Agricultural Experiment Station, University of Arizona, Tucson.

5) "Possibilities for water conservation and maintenance of favorable salt balances on irrigation projects," *chairman,* M. R. Huberty, head, department of irrigation and soils, University of California, Los Angeles.

6) "Prospects for grassland range improvement and conservation in arid areas," *chairman,* K. S. Valentine,

associate professor of animal husbandry, New Mexico College of Agriculture and Mechanic Arts, State College.

7) "Potential relationships between soil conservation practices and watershed yield in arid areas," *chairman,* Robert B. Hickok, supervisor, Southwest Watershed Studies, Agricultural Research Service, U.S. Department of Agriculture, Albuquerque.

8) "Importance of wildlife conservation in arid areas," *chairman,* Walter P. Taylor, visiting lecturer, The Claremont Graduate School, Claremont, Calif.

9) "Possibilities for development of drought-resistant plants for arid areas," *chairman,* Lora M. Shields, department of biology, New Mexico Highlands University, Las Vegas.

10) "Possibilities for desert plant utilization in arid areas," *chairman,* E. F. Castetter, dean, graduate school, and chairman, department of biology, University of New Mexico, Albuquerque.

11) "Possibilities for animal improvement and utilization in arid areas," *chairman,* H. L. Stahnke, head, Department of Biological Science, Arizona State College, Tempe.

12) "Administrative and legal problems of arid land development," *chairman,* R. H. Walker, dean and director, Agricultural Experiment Station, School of Agriculture, Utah State Agricultural College, Logan.

13) Special symposium and discussion group. "Problems of the upper Rio Grande—a typical arid zone watershed," *chairman and program,* to be announced.

30 APRIL–1 MAY

Field trip. The field trip (limited to the first 222 who apply) will leave Albuquerque the morning of 30 April and will proceed to El Paso, Tex., by way of the Estancia Valley and White Sands. Major stops will be made at White Sands, the malpais area west of Carrizozo, and other points. During the evening in El Paso, John H. Leasure, chairman, National Convention of the Cactus and Succulent Society of America, will show colored slides of cacti for those who are interested. On the return from El Paso to Albuquerque on 1 May, the trip will go up the Rio Grande Valley with stops at a large irrigated pecan orchard, a cotton farm, Elephant Butte Dam, and other locations. (Further details about final itinerary and arrangements may be obtained from Dr. J. Linton Gardner, P.O. Box 127, State College, N.M., U.S.A.)

2–4 MAY

Conference (attendance by invitation only). Host institution, New Mexico Institute of Mining and Technology, Socorro.

There is much to be said for the view that the human intellect is a tool devised for dealing with our material environment and is most reliable when so engaged. Divorced from action on the environment, the human intellect turns in on itself and functions as uselessly as a squirrel in a cage, or as the engine of a car before the clutch has been let in.

—EDITORIAL, *Nature*, 19 Aug. 1939.

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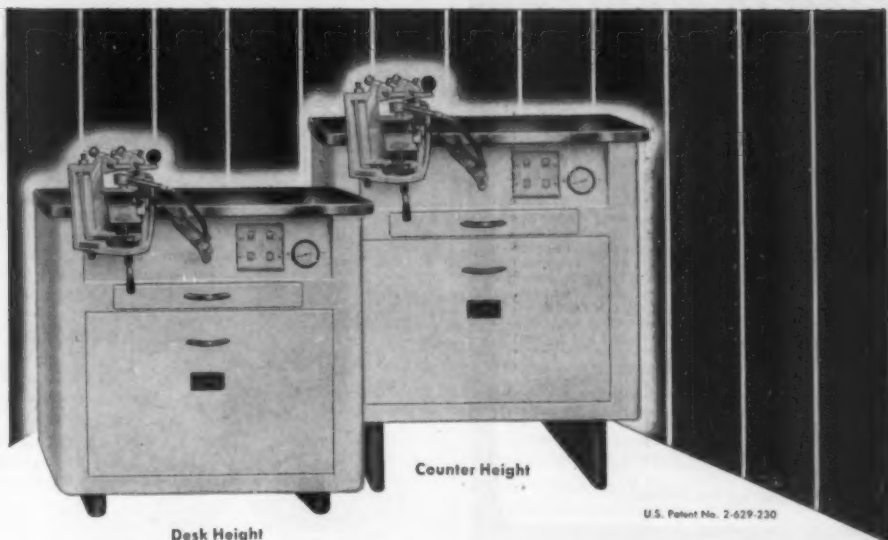
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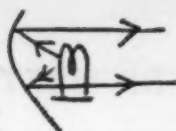
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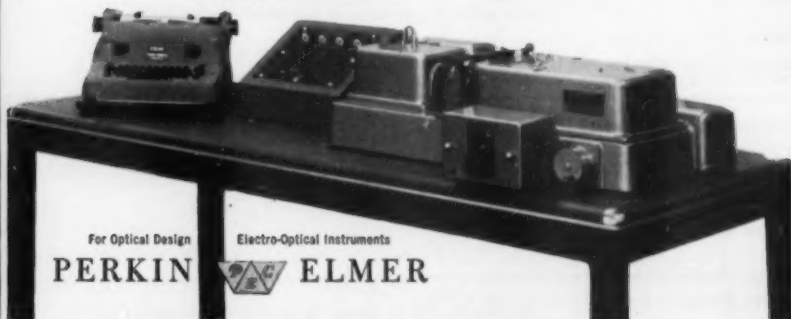
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11 FEBRUARY 1955

3A

INTERNATIONAL ARID LANDS MEETINGS

of the AAAS and its

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

University of New Mexico, Albuquerque, New Mexico, April 26-29

Southwestern Field Trip, Albuquerque-El Paso and return, April 30-May 1

Featuring a **Symposium on What is the Future of Arid Lands?** Public evening lectures, April 26, 27 and 28 by Homer L. Shantz, Charles E. Kellogg, and B. T. Dickson (Australia), and Technical Sessions:

Morning, April 27—Variability and Predictability of Water Supply in Arid Regions—Speakers: Reed W. Bailey, C. W. Thornthwaite, Jean Tixeront (Tunisia), Luna Leopold, F. Dixey (England), C. C. Wallén (Sweden), John H. Dorroh, T. L. Smiley.

Afternoon, April 27—Better Use of Present Resources—Speakers: Kanwar Sain (India), R. O. Whyte (Italy), L. N. McClellan, Hilgard O'R. Sternberg (Brazil), L. A. Richards, Cyril Luker, Raymond Price, Pedro Armillas (Mexico).

Morning, April 28—Prospects for Additional Water Sources—Speakers: E. J. Workman, Edward Bowen (Australia), Sheppard T. Powell, W. F. J. M. Krul (Holland), Vincent J. Shaefer, Glenn W. Brier, H. E. Hayward, Louis Koenig.

Afternoon, April 28—Better Adaptation of Plants and Animals to Arid Conditions—Speakers: Olaf S. Aamodt, Colonel Omar Draz (Egypt), R. Merton Love, Knut Schmidt-Nielsen, Enrique Beltrán (Mexico), B. P. Uvarov (England), Michael Evenari (Israel), L. M. Pultz.

Discussion Group Sessions, April 29 (See SCIENCE of February 11, 1955, or THE SCIENTIFIC MONTHLY of March, 1955, or write to the American Association for the Advancement of Science, 1515 Massachusetts Avenue, N.W., Washington 5, D. C., U.S.A., for details. Cable Address: Advancesci, Washington, D. C.)

Housing Reservation

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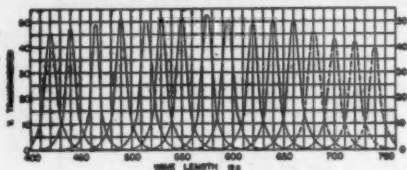
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Advice on Loyalty Requirements

The Office of the President has requested the National Academy of Sciences to appoint a committee to advise on the formulation of Federal Government policy dealing with the relations between questions of loyalty and the award of grants and contracts in support of unclassified scientific research. There follows an exchange of letters between Sherman Adams, The Assistant to the President, and Detlev W. Bronk, president of the National Academy of Sciences, who has been conferring with members of the Administration regarding these matters for some months.—D.W.

Dear Dr. Bronk:

The continued sound and healthy development of our Nation and the protection of the national interests depend to a great degree on the maintenance at full strength of the activities of those who are devoting their lives to scientific research designed to improve the health and well-being of all our people. The role of the Federal Government in support of scientific research has increased to the point where it now sponsors a substantial part of the research activities in the Nation.

In the administration of Government grants and contracts to private institutions for the support of unclassified scientific research, there have been a very small number of occasions when questions have arisen regarding the loyalty of individuals whose work is in connection with these grants and contracts.

When these cases come to the attention of the Government agency administering the program, a problem arises in their handling, inasmuch as it does not involve security but concerns an area outside established Government-wide security procedures for its employees. It is of concern to all Government agencies which support or sponsor such unclassified research. It is of tremendous importance, in the handling of this problem, to avoid misunderstandings between scientists and the Government which might impair the cordial relationships which are so vital to the national welfare, misunderstandings which could lead to a loss of valuable benefits from research. It is equally important that people outside the scientific community understand the nature of the problem, and that their confidence in the Government's handling of this important phase of the public trust be maintained. No one will question the fundamental principle that only those who are loyal to our Government should be beneficiaries of Government grants-in-aid or contracts.

It has been said, "It is a privilege, not a right, to work for the Government." The Government nevertheless recognizes that, in the administration of this principle in

relation to grants and contracts, it is acting, not apart from the people, but as and for the people. Governmental procedures must be designed to protect the reputation and standing of the community of innocent persons.

In the application of these principles the Government expects the cooperation of the grantee or contractor as the case may be. At the same time the Government must take every precaution to guard against harming unjustly any member of the community. Toward this end we are constantly seeking to improve our procedures and at the present time are evaluating various proposals for so doing.

It seems to us that these questions relating to loyalty can best be resolved if scientists, through a representative group such as the National Academy of Sciences, can counsel with the Government on its policy in this matter. Calling upon the Academy in this way is in keeping with its Congressional charter to advise the Government in the formulation of policy to the end that the scientific resources of our country may be fully and effectively utilized. The President has asked me to express to you his strong personal interest in this matter.

I hope that it will be possible for the Academy to take this problem under immediate consideration in order that we may have the benefit of your early advice. If you will get in touch with me, I will arrange a meeting at which these problems can be discussed.

Sincerely/SHERMAN ADAMS

Dear Governor Adams:

I have given careful thought to your recent letter concerning the problems that derive from the appraisal of loyalty to our Government as a basis for the award of grants and contracts in support of unclassified scientific research.

Following the subsequent helpful conference I had with you and other members of the Administration who are intimately concerned, I consulted with many of my colleagues in the National Academy of Sciences. They agree with you and me that it will be desirable for me to appoint a committee of scientists and others to consider the problems in question and to advise with you in the near future. A wise governmental policy relating to these matters is essential if a wholesome environment is to be assured for the furtherance of science and our national welfare. Accordingly, the Academy welcomes the opportunity to aid in the resolution of these troublesome issues.

We warmly appreciate your thoughtful concern for the maintenance of conditions necessary for the satisfactory conduct of research. We are also gratified to know of the President's strong personal interest in this matter.

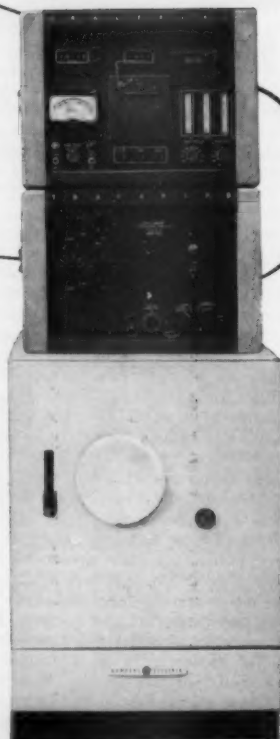
Yours sincerely/DETLEV W. BRONK

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darkroom level, but if you'd rather not bother, your Kodak dealer can handle it for you for processing by processors equipped to do the work.) This new film we identify as *Kodak Ektachrome 135 Film* (for 35mm miniature cameras, 20 exposures for \$1.85) and *Kodak Ektachrome 828 Film* (for cameras like the *Kodak Pony* and *Bantam*, 8 exposures for \$1). Photographic characteristics have been changed substantially from the sheet and roll film *Kodak Ektachrome* because the new film is intended to be viewed at large magnifications, as in projection, and the other isn't.

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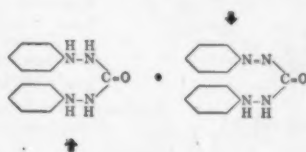
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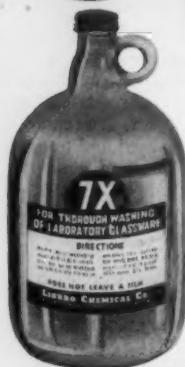
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Meetings & Conferences

March

14. American Educational Research Assoc., Denver, Colo. (F. W. Hubbard, 1201 16 St., NW, Washington 6, D.C.)
- 14-16. North American Wildlife Conference, 20th, Montreal, Canada. (Wildlife Management Inst., 709 Wire Bldg., Washington 5, D.C.)
- 15-17. Electrical Utilization of Aluminum, American Inst. of Electrical Engineers, Pittsburgh, Pa. (N. S. Hibshem, AIEE, 33 W. 39th St., New York 18.)
- 17-19. American Physical Soc., Baltimore, Md. (K. K. Darrow, Columbia University, New York 27.)
- 17-19. International Symposium on Cardiovascular Surgery, Detroit, Mich. (John Keyes, Henry Ford Hospital, Detroit 2.)
- 17-20. Inter-American Statistical Conf., 3rd, Santiago, Chile. (IASI, Pan American Union, Washington 6.)
- 20-23. American Assoc. of Dental Schools, annual, Chicago, Ill. (M. W. McCrea, 42 S. Greene St., Baltimore 1, Md.)
- 20-23. American Inst. of Chemical Engineers, Louisville, Ky. (S. L. Tyler, AICE, 120 E. 41 St., New York 17.)
- 21-23. Aero Medical Assoc., 26th annual, Washington, D.C. (R. J. Benford, P. O. Box 1607, Washington 13.)
- 21-24. Latin American Electroencephalographical Cong., 2nd, Montevideo, Uruguay. (P. Pinto Pupo, Secretary-General, San Paulo, Brazil.)
- 21-24. Latin-American Neurosurgical Congress, 6th, Montevideo, Uruguay. (R. Arana-Iniguez, Convencion 1287, Montevideo.)
- 23-26. International Academy of Proctology, 7th annual, New York. (IAP, 43-55 Kissena Blvd., Flushing, N.Y.)
- 24-26. National Science Teachers Assoc., Cincinnati, Ohio. (R. H. Carleton, 1201 16 St., NW, Washington, D.C.)
- 25-26. Michigan Acad. of Science, Arts and Letters, E. Lansing, Mich. (George M. McEwen, Univ. of Mich., Ann Arbor.)
- 28-31. American Assoc. of Petroleum Geologists, New York, N.Y. (E. H. Powers, Box 670, Fort Worth, Tex.)
- 28-1. Western Metal Exposition, 9th, Los Angeles, Calif. (W. H. Eisenman, 7301 Euclid Ave., Cleveland 3, Ohio.)
- 29-7. American Chemical Soc., 127th national, Cincinnati, Ohio. (A. H. Emery, 1155 16 St., NW, Washington 6.)
- 31-2. Soc. of Research in Child Development Monticello, Ill. (C. B. Stendler, College of Education, Univ. of Illinois, Urbana.)

April

- 1-5. Japan Medical Cong., Kyoto. (M. Goto, Univ. Hospital, Kyoto Univ., Kyoto.)
2. Kappa Delta Pi, Cleveland, Ohio. (E. I. F. Williams, 238 E. Perry St., Tiffin, Ohio.)
- 3-6. American Astronomical Soc., Princeton, N.J. (C. M. Huffer, Washburn Observatory, Madison 6, Wis.)
- 3-7. American College Personnel Assoc., Chicago, Ill. (C. Evans, Univ. of Indiana, Bloomington.)
4. American Educational Research Assoc., Cleveland, Ohio. (F. W. Hubbard, 1201 16 St., NW, Washington, 6, D.C.)
- 4-5. Histochemical Soc. Symposium, Philadelphia, Pa. (A. B. Novikoff, Waldemar Medical Research Foundation, Port Washington, N.Y.)

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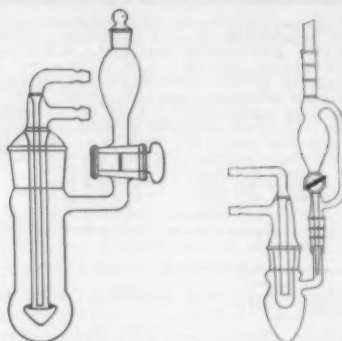
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